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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF ANIMAL INDUSTRY.—BULLETIN No. 88.

A. D. MELVIN; CHIEF OF BUREAU.

THE TUBERCULIN TEST OF HOGS

AND

SOME METHODS OF THEIR INFECTION WITH TUBERCULOSIS.

BY

E. C. SCHROEDER, M. D. V.,

Superintendent of Experiment Station, Bureau of Animal Industry,

AND

JOHN R. MOHLER, V. M. D.,

Chief of Pathological Division, Bureau of Animal Industry.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., June 20, 1906.

Sir: I have the honor to transmit herewith, and to recommend for publication as a bulletin of this Bureau, a manuscript on "The Tuberculin Test of Hogs and Some Methods of their Infection with Tuberculosis," by Drs. E. C. Schroeder and John R. Mohler, of this Bureau.

This article reports two lines of experiments, from which the authors conclude, among other things, that with proper precautions to keep the animals quiet the tuberculin test may be practically applied to hogs with as reliable results as with cattle, and that hogs readily contract tuberculosis through the ingestion of infected food. The experiments indicate that in the common practice of feeding hogs after cattle there is great danger, if the cattle are affected with tuberculosis, of the disease being communicated to the hogs.

Respectfully,

A. D. Melvin,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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THE TUBERCULIN TEST OF HOGS AND SOME METHODS OF THEIR INFECTION WITH TUBERCULOSIS.

INTRODUCTORY.

The increased frequency with which the occurrence of tuberculosis among hogs is being reported calls attention, in addition to the other questions it presents, to the unsatisfactory status of our knowledge relative to the tuberculin test in its application to hogs. The series of experiments recorded in this article were made, at the suggestion and by direction of Dr. A. D. Melvin, Chief of the Bureau of Animal Industry, in order to obtain better information on this subject, and to determine conclusively, if possible, in what measure dependence can be placed on tuberculin used as a diagnostic agent for tuberculosis in hogs; also to gain information as to the manner in which hogs contract tuberculosis in their natural environment.

HOGS USED IN THE EXPERIMENTS.

The hogs used may be divided into five groups:

I. Twelve hogs infected with tuberculosis by feeding them partially with milk to which virulent tubercle bacilli had been added.

II. Four hogs that were fed behind cattle affected with natural tuberculosis.

III. Four hogs that were fed behind cattle affected with tuberculosis by adding tubercle bacilli daily to their drinking water. (Very little water, other than that to which tubercle bacilli had been added, was received by the cattle during the time the hogs of this group were behind them.)

IV. Twelve hogs infected with tuberculosis through subcutaneous inoculation with virulent tubercle bacilli.

V. Twenty-six supposedly normal, healthy hogs.

All these hogs were used in the tuberculin tests, and the hogs of Groups I, II, and III were also used in the experiments with methods of contracting tuberculosis.

All the hogs included in Groups I, II, III, and IV, and one hog of Group V were killed and autopsies held after the conclusion of the tuberculin tests. This leaves 25 hogs of Group V that are still alive

and well. The latter were received from a source from which about 2,000 hogs have been examined postmortem during the last ten years, and among which only two cases of tuberculosis (0.1 per cent) were discovered. Hence it is not regarded as necessary that the 25 animals, not one of which showed the least tendency to react to tuberculin, should be killed and examined postmortem to show more conclusively that they are free from tuberculosis. The probability for each one of the hogs that it is affected, without taking the absence of a tuberculin reaction into consideration, is 1 chance per 1,000 (0.1 per cent), and consequently the chance that a single case of tuberculosis exists among the entire 25 hogs is 25 chances per 1,000, or 1 chance in 40. The one hog of Group V that was killed and examined postmortem showed peculiarities of temperature during the tuberculin test that made an autopsy desirable.

TUBERCULIN AS A DIAGNOSTIC AGENT FOR TUBERCULOSIS IN HOGS.

VARIABILITY OF TEMPERATURE OF HOGS.

Before entering upon a discussion of the tuberculin tests it is desirable to say a few words about the temperature of hogs generally. The normal variations that occur in individual hogs are very great, so great, indeed, within short periods of time, and from apparently inadequate and frequently undiscoverable causes, that it seems at first that they are wholly incompatible with the successful application of a test which depends, for the information that can be derived from it, on a reasonable constancy of the temperature in the absence, and an increase of the temperature in the presence, of a specific disease. In addition to this variation in the individual animal, when the temperature of a number of hogs is compared the difference found is of such magnitude that we are at a loss to conclude what should be regarded as normal.

The hog is an animal that is ordinarily incased in a thick layer of fat, which is a poor conductor of heat and in which the circulation of blood is very meager. Over the fat a skin is stretched in which the circulation of blood is relatively small, and this skin, unlike that of a man or a horse, does not take a prominent part in regulating the bodily temperature through the agency of radiation and perspiration. The covering of a hog may be regarded rather as an excellent means for preventing the escape of heat from, than for regulating the temperature of, the body; hence we have conditions that probably permit of a more rapid production than escape of heat. If we bear this in mind we see how urgently necessary it is that hogs should be kept very quiet for some time before and throughout the duration of a tuberculin (temperature) test.

Normally it seems that fat hogs have a higher temperature than lean ones, and that a higher temperature induced by exercise or some other temporary cause persists longer in fat than in lean hogs.

These general remarks are based on numerous observations of hog temperatures made in the course of the last ten years on other hogs than those included in the tuberculin tests presented in this article.

PRECAUTIONS AGAINST FLUCTUATIONS OF TEMPERATURE.

In these experiments each hog was placed in a rectangular crate about twelve hours before the first temperature was taken, and remained in this confinement continuously until the tuberculin test was completed. The reason for confining the hogs during the tuberculin test was to keep them as quiet as possible, and to prevent increases of temperature incident to physical exertion and nervous excitement. The crates were large enough to permit the hogs to get up and down easily, narrow enough to keep them from turning around, and short enough to prevent too much movement backward and forward. The dimensions found to be satisfactory for hogs ranging in weight from 50 to 150 pounds are (interior measurement): Length, 4 feet; width, 1 foot 2 inches; height, 2 feet.

In the forward end of each crate a small trough for feeding and watering was fastened securely to the floor. The tops of the crates were fastened at the forward or head ends with hinges and at the rear with hasps and staples. At first an attempt was made to have a door at the rear end of each crate, to let down when the attendant was required to approach the hog to insert the thermometer into its rectum; but this arrangement was abandoned because it was found to be much easier to reach the hog from above. The material used in the construction of the crates was miscellaneous pieces of rough lumber 1 inch thick, wire nails, hinges, hasps, and staples. The only tools required were a hatchet and a saw.

Without the use of crates of the kind described, or some equally satisfactory means of restraint, it is difficult, if not impossible, to obtain reliable temperature records of hogs.

The extreme need of quiet is very well illustrated by the temperature of 17 hogs, taken at noon on one day after they had been confined eighteen hours in crates such as have been described, and at noon on another day when it was necessary to catch and hold them in pens 12 feet long by 4 feet wide. In the crates the average temperature was found to be 102.3° F., and in the pens 103.1° F., a difference of 0.8 degree, and this notwithstanding that the pens were very small and the hogs could be caught and held without exercising or exciting them very much.

THE TUBERCULIN TESTS.

The total number of hogs included in the tests was 58; of these 33 were killed and examined postmortem and 25 are still alive. The probability of the presence of disease among the latter has already been discussed (1 chance in 40 that a single one of the 25 hogs is tuberculous), and this is regarded as so remote that it would not be justifiable to sacrifice the hogs for postmortem examination in order to give to the conviction that they are healthy the value of a fully confirmed fact.

The temperature of the first 6 hogs tested was taken hourly for sixteen hours before they were injected with tuberculin, and again hourly for forty hours after the injection. The temperature of the next 14 hogs tested was taken for twenty-three hours before injection, and again hourly for thirty-two hours after injection. In the remaining tests the temperature was taken hourly for twenty-three hours before injection, and again hourly for twenty-five hours after injection. This elaborate system of taking and recording temperature will not be necessary with tuberculin tests of hogs for ordinary purposes; in the experimental tests its need is obvious.

The dose of tuberculin used for each hog was ½ c. c. of the regular tuberculin prepared by the Bureau of Animal Industry per hundredweight or fraction of a hundredweight of hog; that is, no hog received less than ½ c. c., and this was the dose used for all hogs the weight of which was 100 pounds or less; all hogs weighing more than 100 pounds but not more than 200 pounds received 1 c. c. No hog weighing more than 200 pounds was tested; if there had been, the dose would have been increased at the rate of ½ c. c. for every additional 100 pounds or fraction of the same.[a] The dose is relatively larger than that used for testing cattle, and was designedly made so because of the presumably tardier absorption from the subcutaneous tissues of hogs. The tuberculin injected into the hogs caused no objectionable results in a single instance. The seat of injection was directly under the skin that covers the inner surface of the right thigh.

ANALYSIS AND DISCUSSION OF RESULTS.

Among the 58 hogs tested, 26 were found on postmortem examination to be affected with tuberculosis. From the temperature records of the affected animals we obtain the following facts: After an injection with tuberculin the number of hours that pass before a reaction begins varies considerably, and the same is true about the time when the reaction reaches its maximum, and the number of hours during which the reaction persists. The average time when the temperature

[a] The dose of Bureau tuberculin for cattle is 2 c. c. for an adult animal; that is, about ½ c. c. per 200 pounds weight.

first rises above the maximum temperature before injection, and when the reaction reaches its maximum are, respectively, the seventh and the fourteenth hours after injection; and the average number of hours during which the reaction persists and the temperature remains higher than the highest temperature recorded before injection is twenty-three. If we divide the time of the reaction into two periods, one from its beginning to its maximum and the other from its maximum to its termination, we find that on an average the latter period is about twice as long as the former.

An examination of the degrees of temperature recorded after injection for the affected hogs shows that, with two exceptions (hogs Nos. 1754 and 1790), in every instance 105.0° F. was reached, and that the difference between the maximum temperature before injection and after injection in every case excepting two (hogs Nos. 1790 and 1853), was 1 degree or more. From this we conclude that, if the temperature after injection with tuberculin reaches 105.0° F. and is 1 degree higher than the maximum temperature on the previous day, the hog must be regarded as having given a reaction indicative of the presence of tuberculous disease. But as this formula excludes Nos. 1853, 1790, and 1754, it can not be regarded as altogether sufficient.

Hog No. 1853 had a temperature that reached 105.4° F. on the day before injection, and apart from the fact that this was under any circumstances an exceptionally high temperature, entirely too high to justify the application of the tuberculin test, it is shown by the temperature on the second day after injection that it was also an abnormally high temperature for the hog in question. The temperature after injection in this case, however, is so markedly influenced by the injection of tuberculin that very little judgment is required to conclude that a satisfactory reaction occurred, although the difference between the maximum before and after injection is only 0.6° F. We may say that 0.6 degree elevation after injection, above the highest temperature before injection, is a stronger reaction when the maximum before injection is above 105.0° F. than 1 degree when the maximum after injection does not reach higher than 105.0° F.

Hog No. 1790, in the presence of tuberculous disease, clearly failed to react. The lesions found in its body on autopsy, taken all together, would hardly make a mass the size of a pea; but it is just in such slightly affected cases that the reaction among cattle is often greatest, and this hog must be regarded strictly as an instance in which a satisfactory tuberculin failed to cause a temperature reaction.

Hog No. 1754, also a tuberculous animal, gave what would be regarded as a characteristic reaction for cattle; its temperature rose after injection to 1.2 degrees higher than on the day before, but as the highest temperature reached was only 103.8° F., if we keep the lack of constancy shown by hog temperature in mind this must be regarded

as a failure. A reaction of the kind given by this hog should lead to the diagnosis of tuberculosis if the history of the animal is one of exposure to infection; otherwise it must be regarded as negative, or as showing that the hog is free from tuberculosis. The truth of this assertion will be more apparent if we examine the temperature records of some of the healthy hogs, for example, Nos. 1874, 1886, and 1527, which showed a maximum temperature on the day before injection 1 degree or more higher than the maximum temperature on the day after injection. This shows that the movement of the temperature, under the most favorable circumstances for it to remain constant, of a degree or more, has no special diagnostic significance, and stamps hog No. 1754 all the more emphatically as a failure to react.

Hence we have, among the 26 hogs found to be tuberculous on autopsy, 24 hogs in which the presence of disease was clearly indicated by the tuberculin test, and 2 failures. The correct diagnosis represents a trifle more than 92 per cent, and the failures less than 8 per cent.

If we now apply the same system of analysis to the temperature records of the 32 healthy hogs, we find that only one reaction occurred, hog No. 1839, and this hog must justly be removed from the list. It was exposed to infection by eating infected food, and on autopsy was found to have a greatly enlarged and congested submaxillary lymph gland. The submaxillary glands have been shown by experience to be among the very first to become infected with tuberculosis when hogs are exposed to infection through the food they eat. No microscopic examination or inoculation tests with guinea pigs of the gland were made, because it was accidentally soiled during the autopsy of the hog by sectioning it with a knife that had been used to cut tuberculous tissue.

Two other hogs require a few words of explanation—Nos. 1876 and 1895. In both cases the temperature rose to 104.0° F. after injection, which was in the one case 1 degree and in the other 1.4 degrees higher than the maximum temperature before injection. Hog No. 1895, in which the difference of temperature on the day before and the day after injection was the greater, was examined postmortem and found to be perfectly healthy. The temperature of this hog in its gradual rise and decline after injection was very characteristic of a tuberculin reaction, while the elevation in the case of hog No. 1876 was erratic and did not partake of the general character of a reaction. If tuberculosis had been found in either hog the temperature records would have been regarded as failing to indicate its presence. For this reason, together with the failure of the maximum temperature to rise within a degree of the lowest maximum temperature reached during the tuberculin test by any hog affected with tuberculosis and regarded as having given a temperature reaction, these two cases can not be looked

upon as failures. A temperature record like that of hog No. 1895, obtained with a hog that is a member of a tuberculous herd, or is known to have been subjected to exposure, should, however, be regarded as very suspicious, and would justify the slaughter of the animal.

If we eliminate hog No. 1839 which reacted and about the tuberculous character of which some doubt remains, we have 31 healthy hogs that were tested with tuberculin, all of which failed to react, or successful determination of the absence of tuberculosis in 100 per cent of cases. The dependence that can be placed on tuberculin when the total number of hogs is considered, 26 tuberculous and 31 healthy, or 57 animals, among which two failures occurred, gives us the high figure of 96.49 per cent.

Ten of the hogs were tested a second time, about forty days after the conclusion of the first test. Of these, 6 reacted with both tests, 2 failed to react with both tests, and 2 failed with the first and reacted with the second test. The 6 that reacted with both tests were all tuberculous, the 2 that failed with both tests were free from disease, and the 2 that failed with the first and reacted with the second test were tuberculous. The latter 2 hogs belonged to Group III, and probably did not become affected with tuberculosis until after the first test was made. The lesions were all of a very recent character, and the disease, which usually progresses very rapidly in hogs exposed to the kind of tubercle bacillus with which these hogs became infected, was of limited extent.

The amount of time and labor required to make tuberculin tests in the elaborate manner that was practiced with the tests presented in this article is greatly in excess of what is practically necessary. It has been shown that the average length of time after injection for the reaction to begin is seven hours, that the maximum is reached seven hours later, and that the reaction continues sixteen hours after the maximum. The beginning and continuation of the reaction is regarded to be the uninterrupted elevation of the temperature actually above the maximum temperature recorded previous to injection.

If we reduce the number of times the temperature is taken, the three given figures should answer as a guide as to the best time to take it. Since the average number of hours after injection in which the maximum is reached is fourteen, the temperature should be taken in all tests on or about the fourteenth hour after injection; and since the time required for the temperature to rise from the beginning of a reaction to its maximum is only about half as long as the reaction endures after the maximum is reached, we may regard it as a rule that for every one time the temperature is taken before the fourteenth hour it should be taken two times after it.

If the reliability of our temperature records is estimated on the bases of the temperature recorded ten, twelve, fourteen, sixteen, eighteen, and twenty hours after injection with tuberculin, it will be found that they neither gain nor lose any portion of their diagnostic significance.

SUGGESTIONS FOR PRACTICAL APPLICATION OF THE TUBERCULIN TEST TO HOGS.

For a practical tuberculin test we suggest that the temperature of hogs be taken every two hours, from 8 a. m. to 6 p. m., inclusive, on the day of injection; that the tuberculin injection be made at 10 p. m., and the temperature again taken every two hours the day after injection from 8 a. m. to 6 p. m. The temperature before injection should be taken as frequently as after injection, and at corresponding hours, because of the very erratic character of the temperature of hogs, and because of the slight circumstances that may influence it to a very marked degree. And it is urged, above all things, that the hogs be kept very quiet throughout the entire test, and that the test be regarded in this connection to have its beginning at least twelve hours before the first temperature is taken.

Every man who uses tuberculin as a diagnostic agent must, of course, use a reasonable amount of judgment when he studies the significance of the temperature records he obtains, else he will meet with many disappointments and will soon come to undervalue the true reliability of this valuable substance.

Aside from the importance that must be attached to the difference between the maximum temperature before and after injection, the manner in which the temperature rises, the time it remains elevated, and the manner in which it drops back to normal must receive consideration. A single enormously high temperature, with a low temperature directly before and after it, is more apt to be an erratic occurrence without special significance than a tuberculin reaction. A reaction should show some persistence, though it need not remain at its maximum a long time. A good method, when doubt exists regarding the value of an elevation of temperature, is to subtract the sum of the degrees recorded before injection from the sum of the degrees recorded after injection, and to divide the remainder by the number of records made each day. For example, if we apply this method to hog No. 1853, and use the six temperature records obtained on each day at the hours recommended for a practical tuberculin test, we have the following:[a]

[a] The injection of tuberculin was made at 11 p. m., hence the tenth, twelfth, fourteenth, sixteenth, eighteenth, and twentieth hours after injection occur at 9 and 11 a. m., and 1, 3, 5, and 7 p. m.

Temperature of hog No. 1853.

Hour.	Temperature before injection.	Temperature after injection.
	° F.	° F.
9 a. m.	102.6	104.0
11 a. m.	103.6	105.0
1 p. m.	103.0	105.8
3 p. m.	104.2	106.0
5 p. m.	104.8	105.8
7 p. m.	105.4	103.8
Total	623.6	630.4

630.4—623.6=6.8
6.8÷6=1.13⅓

We see here that a persistent difference of 1.13⅓ degrees was present in this hog between the two days, notwithstanding that the difference between the maximum temperature recorded for each of the two days shows a difference of only 0.6 degree.

If we apply this same test to hog No. 1876, the maximum temperature of which on the day after injection was 1.6 degrees higher than on the previous day, we find that the persistent difference is only 0.26⅔ degree. Hence the great difference between the maximum records for the two days is dependent upon one erratic elevation on the day after injection, which should have no diagnostic significance.

Hog No. 1853 was tuberculous and hog No. 1876 was healthy.

If we apply this system of averaging the temperature to all the hogs, and leave the question of elevation to any particular point and the difference between daily maximum records entirely out of consideration, and insist on a persistent elevation of only 1 degree after injection, we will find that among our 68 tuberculin tests only two failures occurred, hog No. 1790, which failed to react in the presence of tuberculosis, and hog No. 1895, which reacted in the absence of tuberculosis.

For averaging the temperature in this manner it is necessary to use the same number of records for each day of the test, and preferably records made at corresponding hours. When the same number of records have not been made on each of the two days the sum for each day must first be divided by the number of records of which it consists and the subtraction made afterwards; that is, a simple method of subtracting the average temperature of one day from the average of the other must be used.

The following table is based on the suggestion made regarding the hours at which the temperature of hogs should be taken during a practical tuberculin test; that is, the reactions and failures to react are presented in the table by using only the temperature recorded in the general temperature tables for the tenth, twelfth, fourteenth, six-

teenth, eighteenth, and twentieth hours after injection with tuberculin, and the corresponding hours on the day before injection:

Results of tests compiled on basis proposed for practical tests.

Number of hog.	Maximum temperature.		Elevation of temperature in degrees F.	Reaction (+), or absence of reaction (−). (a)	Remarks.b
	Before injection.	After injection.			
	° F.	° F.	° F.		
1853	105.4	106.0	0.6	c +	Tuberculous.
1854	105.4	107.2	1.8	+	Do.
1855	104.0	106.2	2.2	+	Do.
1856	103.6	106.2	2.6	+	Do.
1857	103.4	105.0	1.6	+	Do.
1858	103.6	104.0	0.4	−	Healthy.
1845	102.4	105.6	3.2	+	Tuberculous.
1846	103.2	107.4	4.2	+	Do.
1847	103.0	107.2	4.2	+	Do.
1848	103.4	107.6	4.2	+	Do.
1849	103.4	106.6	3.2	+	Do.
1850	103.6	106.6	3.0	+	Do.
1837	103.8	104.2	0.4	−	Healthy.
1838	103.0	103.2	0.2	−	Do.
1839	103.2	105.0	1.8	+	Probably tuberculous, diagnosis doubtful.
1840	103.8	103.4	−0.4	−	Healthy.
1841	103.2	103.6	0.4	−	Do.
1842	103.6	106.4	2.8	+	Tuberculous.
1843	103.0	103.8	0.8	−	First test; probably not tuberculous at this time.
	101.6	105.0	3.4	+	Second test; recent tuberculosis from feeding experiment.
1844	104.2	104.6	0.4	−	First test; same as hog No. 1843.
	103.6	106.6	3.0	+	Second test; same as hog No. 1843.
1877	103.4	103.2	−0.2	−	Healthy, alive.
1878	103.2	103.2	0.0	−	Do.
1879	102.8	102.8	0.0	−	Do.
1874	103.6	102.6	−1.0	−	Do.
1875	103.6	103.6	0.0	−	Do.
1876	102.4	104.0	1.6	−	Do.
1880	103.4	103.6	0.2	−	Do.
1881	103.0	102.4	−0.6	−	Do.
1883	103.4	103.0	−0.4	−	Do.
1884	103.0	102.8	−0.2	−	Do.
1885	103.4	103.2	−0.2	−	Do.
1886	103.8	102.4	−1.4	−	Do.
1887	103.8	103.6	−0.2	−	Do.
1888	103.6	103.6	0.0	−	Do.
1889	103.8	103.8	0.0	−	Do.
1891	103.4	102.8	−0.6	−	Do.
1751	102.6	106.2	3.6	+	Tuberculous.
1754	102.6	103.8	1.2	d−	Do.
1755	103.0	105.2	2.2	+	Do.
1772	102.4	105.6	3.2	+	Do.
1783	102.0	105.6	3.6	+	Do.
1790	101.6	102.8	1.2	d−	Do.
1798	103.2	106.0	2.8	+	Do.
1801	102.6	105.6	3.0	+	Do.
1803	103.6	106.0	2.4	+	Do.
1805	102.2	105.0	2.8	+	Do.
1809	102.8	106.4	3.6	+	Do.
1811	103.2	106.2	3.0	+	Do.

a The presence of a reaction is based on the elevation of the temperature on the day after injection to at least one degree above the maximum temperature of the previous day, and an actual elevation of the temperature to 105.0° F.

b Excepting when the statement is made that the hog is alive, the condition relative to the presence or absence of disease was determined by a postmortem examination.

c This one animal is made an exception to the above rule (a) because of the extremely high temperature before injection with tuberculin Errors of diagnosis would probably be reduced if hogs with temperatures above 105° F. were excluded from the tuberculin test.

d Hogs Nos. 1754 and 1790, according to the foregoing rule (a) for determining the presence or absence of a reaction, are the only cases among the total of 68 tuberculin tests made and presented that failed to show a temperature condition in harmony with the presence or absence of tuberculosis. The results show that when the hogs are handled with care, and the temperature is taken at intervals of two hours only six times before injection and again at intervals of two hours six times after injection, the reliability of the tuberculin test for hogs is 97+ per cent.

Results of tests compiled on basis proposed for practical tests—Continued.

Number of hog.	Maximum temperature.		Elevation of temperature in degrees F.	Reaction (+), or absence of reaction (−).	Remarks.
	Before injection.	After injection.			
	° F.	° F.	° F.		
1383	101.8	101.4	−0.4	−	Healthy, alive.
1384	102.0	102.0	0.0	−	Do.
1385	103.0	102.4	−0.6	−	Do.
1399	101.4	102.0	0.6	−	Do.
1446	101.8	102.0	0.2	−	Do.
1527	102.6	101.4	−1.2	−	Do.
1895	102.2	103.8	1.6	−	Healthy on autopsy.
1896	102.2	101.4	−0.8	−	Healthy, alive.
1897	103.0	103.2	0.2	−	Do.
1898	103.2	103.4	0.2	−	Do.
1854	103.4	106.4	3.0	+	Second test; tuberculous.
1855	103.4	106.4	3.0	+	Do.
1856	104.4	105.4	1.0	+	Do.
1846	102.0	106.4	4.4	+	Do.
1848	103.6	105.6	2.0	+	Do.
1849	103.4	105.4	2.0	+	Do.
1838	102.2	101.6	−0.6	−	Second test; healthy.
1840	102.6	103.0	−0.4	−	Do.

COMPARATIVE VARIATION IN TEMPERATURES OF HOGS, OTHER ANIMALS, AND MEN.

The readiness with which the temperature of hogs rises and its erratic character is probably, in addition to other causes, to a great extent dependent upon the fact that they have relatively small lungs. When we think of the enormous surface that is exposed in the respiratory passages to the air we breathe, and the remarkable vascularity of this surface, we can not fail to receive the impression that one of the important functions of the organs of respiration is to aid in the regulation of the bodily temperature. The lung and the upper air passages are as nicely adapted for removing heat from the body, or for effecting the escape of the heat that is generated during the various metabolic processes, as an extensive network of pipes constantly immersed, in order to cool their contents, in a moving fluid of low temperature. The air we inspire is comparatively cool and dry; the air we expire is comparatively warm and moist; hence, the cooling process is dependent both upon the absorption of heat and upon the vaporization and the absorption by the air of moisture.

Panting or rapid breathing after exercise and during fever is less due to the need for an increased supply of oxygen than to an effort on the part of the respiratory organs to hasten the escape of heat. F. Smith, in his work on physiology, asserts that the percentage of oxygen lost and carbonic acid gained by the expired air during heavy work may fall below that observed in a state of repose, and attributes this circumstance to the larger volume of air that passes to and from the lung.

It is a well-known fact that the temperature of man is more constant than that of the lower animals; in his case a variation from the normal, which is a definitely established mark dealing with fractions of a degree, is either of very short duration or positively signifies that an abnormal process is active in his body. The reason for this is clearly apparent—a large respiratory surface, and an active, normally, almost bare or artificially covered skin. Among the domestic animals the horse, with its large lung and its active but covered skin, has a temperature that ranks next to that of man in regularity; and the hog, with its fat covered body, inert skin, and small lung, stands practically at the very end of the line of temperature constancy and regularity.

The following experiment was made to obtain further information on this point, and gives an emphatic illustration of the greater effect of exercise on the temperature of hogs than on that of man and other animals.

2 hogs were driven 200 meters (⅛ mile[a]) in 4 minutes.
2 men ran 400 meters (¼ mile) in 3 minutes.
2 horses were ridden 800 meters (½ mile) in 3 minutes.
2 cattle were driven 800 meters (½ mile) in 5 minutes.

The temperature records were as follows:

The temperatures of hogs, men, horses, and cattle before and after exercise.

	Hogs.		Men.		Horses.		Cattle.	
	No. 1.	No. 2.	No. 1.	No. 2.	No. 1.	No. 2.	No. 1.	No. 2.
Before exercise	102.0	102.6	98.2	98.4	100.2	99.9	101.0	102.0
Immediately after	106.4	106.0	98.8	98.7	100.6	100.6	101.2	102.8
5 minutes after	106.4	105.8	99.0	98.6	101.4	101.3	101.8	103.0
10 minutes after	106.2	104.8	98.6	98.4	101.4	101.2	102.0	103.0
20 minutes after	104.6	104.4	98.6	98.4	101.2	101.0	102.0	103.0
30 minutes after	104.1	104.1	98.6	98.4	101.0	101.0	102.0	102.6
60 minutes after	103.8	103.6	98.6	98.4	100.6	100.8	102.0	102.4

The temperature of the two hogs the day following that on which the exercise was received, after they had been confined between eighteen and twenty hours in crates of the kind previously described, was: No. 1, 101.8° F.; No. 2, 102.4° F. The crates, immediately after this temperature was taken, with the hogs in them, were carefully lifted on a farm wagon and carried on the wagon back to the pens in which the hogs belonged, a distance of 200 meters, or one-eighth of a mile. As a result of the attendant excitement for the hogs, their temperature was raised: No. 1 to 102.4° F., and No. 2 to 103.2° F., an increase, respectively, of 0.6° and 0.8° F. The hogs were carefully taken from the crates, and just before releasing them in the pens their temperature was taken again, and was found to be: No. 1,

[a] This figure is not absolutely correct. 200 meters contain 656.166+ feet, and ⅛ mile 660 feet.

103.3° F., and No. 2, 103.8° F.; a further increase of 0.9° and 0.6° F., respectively. The whole process, taking temperature, moving the hogs, and turning them back into the pens, was accomplished in about thirty minutes, and was done in a quiet and methodical manner, and yet caused an increase in the temperature of the hogs, for No. 1 of 1.5° F., and for No. 2 of 1.4° F.

The effect of the exercise on the respiration of the men and several animals was as follows:

	Number of respirations per minute.		Approximate increase of volume of air breathed with each inspiration after exercise.
	Before exercise.	After exercise.	
Hogs	40 to 50	50 to 60	Four to five times the normal.
Men	18 to 20	28 to 30	Three to four times the normal.
Horses	12 to 14	40 to 50	No apparent increase.
Cattle	16 to 20	70 to 80	Do.

The effect on the respiration endured much longer with the hogs than with the men and other animals. The effect on the horses was of very short duration relative to the number of respirations, but before the breathing became entirely normal for a state of rest the increased rapidity was changed to an increased depth. The volume of air breathed by the cattle with each inspiration remained apparently constant.

It was impossible to obtain a record of the pulse beats for the hogs. The men showed an average increase from 78 beats per minute to 130, the horses from 36 to 70, and the cattle from 44 to 96. The return of the pulse and respiration to the normal for a state of rest was practically parallel.

It is a well-known fact that the energy required to do work increases very rapidly as the time in which it is done diminishes. For this reason, when the value of the results given in the tables is estimated, it must be borne in mind that the work done by the men in three minutes is twice that done by the hogs in four minutes, that done by the horses is four times as much in three minutes, and that by the cattle four times as much in five minutes.

The hogs used in this test were ordinary young farm animals of the kind and in the condition commonly found on American farms. The men were a clerk who leads a very sedentary life (No. 1) and a laborer (No. 2). Both men were thoroughly exhausted after the run, from what was for them an unusual form of exercise. The horses were a pair of heavy, quite fat, work animals, and did a kind of work to which they are accustomed, but did it at more than double the usual speed, and each horse carried on its back a man whose weight was at least 175 pounds. The cattle were a cow (No. 1) that had not been out

of her stall for several months and a heifer (No. 2) that was daily turned out in a small pasture.

The increase of temperature because of the exercise was as follows:

Hogs—
No. 1, from 102.0 to 106.4=4.4 degrees.
No. 2, from 102.6 to 106.0=3.4 degrees.
Men—
No. 1, from 98.2 to 99.0=0.8 degree.
No. 2, from 98.4 to 98.7=0.3 degree.
Horses—
No. 1, from 100.2 to 101.4=1.2 degrees.
No. 2, from 99.9 to 101.3=1.4 degrees.
Cattle—
No. 1, from 101.0 to 102.0=1.0 degree.
No. 2, from 102.0 to 103.0=1.0 degree.

The exercise given the horses—two fat, slow, work horses, each with a heavy man on its back, going half a mile at the rate of 10 miles an hour—is greatly in excess of that done by the men or the other animals, and consequently next to the hogs, they show the greatest elevation of temperature; but even in their case the elevation is incomparably less than in the hogs. If a walk, lasting four minutes, in which the distance covered is only one-eighth of a mile (the speed being less than 2 miles per hour), can elevate the temperature of a hog as much as 3.4 to 4.4 degrees (and that this is just what does occur we have experimentally demonstrated), our reiterated caution that hogs must be kept quiet, beginning some time before and during the entire course of a tuberculin test, will bear still another repetition. Without quiet an application of the tuberculin test will be found to be a hopeless, thankless, and unsatisfactory task from which no results can be gained, and which can lead to nothing but useless labor and a confused lot of temperature records from which no conclusions can be drawn. On the other hand, the tests we have made and presented clearly show that the tuberculin test has a high value, closely approaching absolute accuracy, when the hogs are treated in conformity with our suggestions.

TEMPERATURE AND AUTOPSY RECORDS.

The temperature records of all the hogs tested and the autopsy records of the 33 hogs that were killed and examined postmortem follow:

Temperature Tables.

Table showing the temperature of hogs before and after injection.

HOG NO. 1853 (T).			
Hour.	Feb. 14, before injection.	Feb. 15, after injection.	Feb. 16, after injection.
	°F.	°F.	°F.
1 a. m	.....	104.4	103.4
2 a. m	.....	103.4	104.4
3 a. m	.....	102.6	104.6
4 a. m	.....	103.0	104.6
5 a. m	.....	103.2	103.0
6 a. m	.....	104.0	103.2
7 a. m	.....	102.4	103.0
8 a. m	102.0	104.8	103.4
9 a. m	102.6	104.0	103.6
10 a. m	103.8	105.6	104.0
11 a. m	103.6	105.0	103.8
12 m	102.6	105.6	104.6
1 p. m	103.0	105.8	104.2
2 p. m	103.4	106.0	104.0
3 p. m	104.2	106.0	104.0
4 p. m	105.0	106.0	103.8
5 p. m	104.8	105.8	.....
6 p. m	105.4	105.0	.....
7 p. m	105.4	103.8	.....
8 p. m	105.0	102.6	.....
9 p. m	104.6	104.4	.....
10 p. m	104.0	105.6	.....
11 p. m	[a] 104.2	103.2	.....
12 p. m	104.0	103.4	.....

HOG NO. 1855. (T.)			
Hour.	Feb. 14, before injection.	Feb. 15, after injection.	Feb. 16, after injection.
	°F.	°F.	°F.
1 a. m	.....	104.0	104.6
2 a. m	.....	104.6	104.6
3 a. m	.....	104.0	105.6
4 a. m	.....	105.0	104.6
5 a. m	.....	105.4	104.0
6 a. m	.....	106.2	104.0
7 a. m	.....	106.2	104.2
8 a. m	104.6	105.0	103.6
9 a. m	103.8	106.4	104.4
10 a. m	103.4	106.2	103.6
11 a. m	103.8	106.0	104.0
12 m	103.8	106.4	104.0
1 p. m	103.8	106.2	104.2
2 p. m	103.4	106.6	104.2
3 p. m	103.6	106.2	103.8
4 p. m	103.6	107.0	104.0
5 p. m	103.8	105.4	.....
6 p. m	103.6	106.0	.....
7 p. m	104.0	105.8	.....
8 p. m	104.2	105.8	.....
9 p. m	103.8	106.0	.....
10 p. m	104.6	106.0	.....
11 p. m	[a] 104.6	105.0	.....
12 p. m	104.2	105.6	.....

HOG NO. 1854 (T).			
	°F.	°F.	°F.
1 a. m	.....	104.0	105.6
2 a. m	.....	105.0	105.4
3 a. m	.....	104.4	105.6
4 a. m	.....	104.2	104.6
5 a. m	.....	105.0	104.8
6 a. m	.....	104.4	104.6
7 a. m	.....	105.4	104.6
8 a. m	104.0	105.2	104.2
9 a. m	104.4	105.4	104.2
10 a. m	104.6	106.0	104.0
11 a. m	104.6	106.2	103.8
12 m	104.0	107.8	104.2
1 p. m	103.8	106.8	104.0
2 p. m	103.4	107.2	104.0
3 p. m	103.4	107.2	104.2
4 p. m	105.0	106.8	104.0
5 p. m	105.4	105.8	.....
6 p. m	104.8	106.6	.....
7 p. m	105.0	106.0	.....
8 p. m	104.4	106.0	.....
9 p. m	103.8	107.0	.....
10 p. m	104.4	106.2	.....
11 p. m	[a] 104.2	106.4	.....
12 p. m	104.6	106.0	.....

HOG NO. 1856. (T.)			
	°F.	°F.	°F.
1 a. m	.....	102.8	104.4
2 a. m	.....	103.0	103.8
3 a. m	.....	103.2	102.4
4 a. m	.....	103.0	102.2
5 a. m	.....	102.6	102.8
6 a. m	.....	103.6	102.2
7 a. m	.....	104.6	102.4
8 a. m	102.2	105.0	102.2
9 a. m	102.2	106.2	102.6
10 a. m	102.8	105.8	102.6
11 a. m	103.6	106.2	103.6
12 m	103.0	106.0	103.6
1 p. m	102.8	105.8	103.8
2 p. m	103.2	105.8	103.4
3 p. m	103.4	106.0	103.4
4 p. m	103.4	106.0	104.0
5 p. m	103.0	105.2	.....
6 p. m	102.6	105.0	.....
7 p. m	103.4	104.4	.....
8 p. m	103.0	104.2	.....
9 p. m	103.0	104.4	.....
10 p. m	102.6	104.4	.....
11 p. m	[a] 102.6	104.0	.....
12 p. m	103.0	104.8	.....

[a] Injected with ½ c. c. of tuberculin at this hour.

NOTE.—The letter (T) placed after the number of a hog signifies that it was found to be affected with tuberculosis when examined postmortem. The letter (H) after the number of a hog signifies that it was found to be free from tuberculous disease on postmortem examination. The letter (A) after the number of a hog signifies that it is alive, and without doubt free from tuberculosis or other disease.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1857. (T.)

Hour.	Feb. 14, before injection.	Feb. 15, after injection.	Feb. 16, after injection.
	°F.	°F.	°F.
1 a. m	.....	103.2	103.6
2 a. m	.....	103.2	104.0
3 a. m	.....	103.2	104.0
4 a. m	.....	104.4	103.4
5 a. m	.....	103.4	103.8
6 a. m	.....	102.6	103.6
7 a. m	.....	102.6	104.0
8 a. m	103.0	103.0	103.8
9 a. m	103.4	103.6	104.0
10 a. m	103.6	104.2	103.4
11 a. m	103.0	104.0	104.0
12 m	103.4	104.6	103.2
1 p. m	102.0	104.6	103.8
2 p. m	102.2	104.6	103.6
3 p. m	102.6	104.0	103.2
4 p. m	103.6	104.2	103.4
5 p. m	103.0	103.6	.....
6 p. m	102.6	104.0	.....
7 p. m	103.2	105.0	.....
8 p. m	102.6	103.8	.....
9 p. m	103.0	104.4	.....
10 p. m	102.6	104.4	.....
11 p. m	[a] 102.2	104.2	.....
12 p. m	103.2	104.0	.....

HOG NO. 1845. (T.)

Hour.	Feb. 20, before injection.	Feb. 21, after injection.	Feb. 22, after injection.
	° F.	° F.	° F.
1 a. m	100.4	101.0	104.4
2 a. m	100.2	100.8	104.4
3 a. m	100.6	100.4	104.6
4 a. m	100.6	100.6	104.4
5 a. m	101.2	102.0	104.4
6 a. m	101.2	102.4	104.4
7 a. m	101.2	102.0	104.0
8 a. m	102.4	102.6	104.2
9 a. m	102.4	103.0	.....
10 a. m	101.4	104.4	.....
11 a. m	101.4	104.4	.....
12 m	102.0	104.8	.....
1 p. m	101.6	105.2	.....
2 p. m	101.6	105.0	.....
3 p. m	101.8	105.6	.....
4 p. m	102.2	103.2	.....
5 p. m	102.4	103.2	.....
6 p. m	101.8	104.4	.....
7 p. m	101.8	104.4	.....
8 p. m	101.6	105.2	.....
9 p. m	101.4	104.4	.....
10 p. m	101.4	104.8	.....
11 p. m	[a] 101.6	105.0	.....
12 p. m	101.6	104.8	.....

HOG NO. 1858. (H.)

	°F.	°F.	°F.
1 a. m	.....	103.4	104.2
2 a. m	.....	103.4	104.0
3 a. m	.....	103.2	104.0
4 a. m	.....	103.0	104.0
5 a. m	.....	103.8	104.0
6 a. m	.....	103.8	104.0
7 a. m	.....	103.6	104.2
8 a. m	103.2	103.6	103.6
9 a. m	102.8	103.4	104.0
10 a. m	103.4	103.2	103.2
11 a. m	103.2	103.6	104.0
12 m	103.2	103.8	103.4
1 p. m	103.0	103.4	102.8
2 p. m	102.6	104.4	103.4
3 p. m	103.6	104.0	103.4
4 p. m	103.4	104.0	103.2
5 p. m	103.4	104.0	.....
6 p. m	103.6	104.2	.....
7 p. m	103.6	104.0	.....
8 p. m	104.0	103.4	.....
9 p. m	103.6	104.4	.....
10 p. m	103.2	104.6	.....
11 p. m	[a] 103.6	104.4	.....
12 p. m	103.8	103.8	.....

HOG NO. 1846. (T.)

	°F.	°F.	°F.
1 a. m	102.4	102.0	105.0
2 a. m	102.6	102.2	104.6
3 a. m	101.2	102.0	104.0
4 a. m	102.4	102.2	104.0
5 a. m	102.6	102.6	103.8
6 a. m	102.4	104.6	103.6
7 a. m	102.4	105.8	103.2
8 a. m	102.8	106.6	103.2
9 a. m	103.2	107.0	.....
10 a. m	103.0	107.0	.....
11 a. m	102.8	107.2	.....
12 m	102.4	107.6	.....
1 p. m	102.4	107.4	.....
2 p. m	102.4	106.8	.....
3 p. m	102.0	107.4	.....
4 p. m	102.6	107.0	.....
5 p. m	102.2	106.4	.....
6 p. m	102.2	106.6	.....
7 p. m	101.8	106.4	.....
8 p. m	102.0	105.8	.....
9 p. m	101.8	105.8	.....
10 p. m	101.6	104.8	.....
11 p. m	[a] 101.4	104.6	.....
12 p. m	102.0	105.0	.....

[a] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1847. (T.)

Hour.	Feb. 20, before injection.	Feb. 21, after injection.	Feb. 22, after injection.
	°F.	°F.	°F.
1 a. m	100.4	101.4	106.2
2 a. m	101.2	101.6	106.0
3 a. m	102.0	102.0	106.0
4 a. m	101.6	102.0	106.0
5 a. m	101.2	102.4	105.8
6 a. m	101.2	103.0	105.8
7 a. m	101.6	104.0	104.6
8 a. m	102.0	105.2	104.2
9 a. m	103.0	105.6	.....
10 a. m	102.2	106.4	.....
11 a. m	102.8	107.0	.....
12 m	102.2	107.0	.....
1 p. m	102.4	107.2	.....
2 p. m	102.4	106.4	.....
3 p. m	102.2	107.0	.....
4 p. m	102.8	106.6	.....
5 p. m	102.4	106.4	.....
6 p. m	102.2	106.4	.....
7 p. m	102.0	106.2	.....
8 p. m	101.8	106.0	.....
9 p. m	101.8	105.4	.....
10 p. m	101.6	106.4	.....
11 p. m	[a]102.2	106.2	.....
12 p. m	101.6	106.8	.....

HOG NO. 1849. (T.)

Hour.	Feb. 20, before injection.	Feb. 21, after injection.	Feb. 22, after injection.
	°F.	°F.	°F.
1 a. m	101.2	102.0	105.8
2 a. m	101.2	101.8	105.2
3 a. m	101.4	102.2	104.8
4 a. m	102.0	102.2	104.6
5 a. m	101.6	102.6	104.6
6 a. m	102.2	103.0	104.2
7 a. m	102.6	103.2	103.4
8 a. m	102.8	103.4	103.6
9 a. m	103.4	104.0	.....
10 a. m	102.8	105.0	.....
11 a. m	102.6	105.8	.....
12 m	102.8	106.0	.....
1 p. m	102.6	106.0	.....
2 p. m	102.4	106.2	.....
3 p. m	102.2	106.0	.....
4 p. m	102.4	105.8	.....
5 p. m	103.0	106.6	.....
6 p. m	103.0	107.0	.....
7 p. m	102.6	106.0	.....
8 p. m	102.4	106.0	.....
9 p. m	102.4	105.8	.....
10 p. m	102.2	106.0	.....
11 p. m	[a]102.2	106.0	.....
12 p. m	102.4	105.2	.....

HOG NO. 1848. (T.)

	°F.	°F.	°F.
1 a. m	102.4	102.4	103.4
2 a. m	102.4	102.8	103.6
3 a. m	102.8	103.6	103.2
4 a. m	102.8	103.4	103.2
5 a. m	102.8	104.8	102.2
6 a. m	102.8	106.0	102.4
7 a. m	102.6	106.2	103.2
8 a. m	103.0	106.2	103.4
9 a. m	103.4	106.6	.....
10 a. m	103.0	107.2	.....
11 a. m	102.8	107.2	.....
12 m	102.6	107.4	.....
1 p. m	102.6	107.0	.....
2 p. m	102.8	107.6	.....
3 p. m	102.8	107.6	.....
4 p. m	102.6	105.6	.....
5 p. m	103.2	106.4	.....
6 p. m	102.8	106.4	.....
7 p. m	103.0	106.4	.....
8 p. m	102.8	106.0	.....
9 p. m	102.0	105.8	.....
10 p. m	102.4	104.8	.....
11 p. m	[a]102.0	104.4	.....
12 p. m	102.4	104.0	.....

HOG NO. 1850. (T.)

	°F.	°F.	°F.
1 a. m	102.2	102.4	106.2
2 a. m	102.4	102.4	106.0
3 a. m	102.2	102.6	105.4
4 a. m	102.4	102.8	105.2
5 a. m	102.4	102.6	105.4
6 a. m	102.8	103.0	104.8
7 a. m	102.6	103.4	104.8
8 a. m	103.4	104.0	104.8
9 a. m	103.6	105.0	.....
10 a. m	103.0	105.4	.....
11 a. m	103.0	105.6	.....
12 m	102.8	106.2	.....
1 p. m	102.4	105.6	.....
2 p. m	102.8	106.6	.....
3 p. m	103.2	106.4	.....
4 p. m	102.8	106.0	.....
5 p. m	102.8	105.0	.....
6 p. m	102.2	106.4	.....
7 p. m	102.0	106.6	.....
8 p. m	102.2	106.4	.....
9 p. m	102.4	106.6	.....
10 p. m	102.2	106.0	.....
11 p. m	[a]102.4	106.0	.....
12 p. m	102.6	106.0	.....

[a] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1837. (H.)

Hour.	Feb. 27, before injection.	Feb. 28, after injection.	Mar. 1, after injection.
	°F.	°F.	°F.
1 a. m.	102.4	103.2	102.6
2 a. m.	101.6	102.4	102.6
3 a. m.	102.2	102.4	103.2
4 a. m.	102.6	102.4	102.6
5 a. m.	102.6	102.4	102.4
6 a. m.	102.6	102.4	102.2
7 a. m.	102.6	103.2	102.0
8 a. m.	102.8	104.2	.....
9 a. m.	103.4	104.2	.....
10 a. m.	102.6	103.4	.....
11 a. m.	103.2	104.0	.....
12 m	102.4	103.6	.....
1 p. m.	103.8	103.6	.....
2 p. m.	103.2	103.0	.....
3 p. m.	103.0	103.0	.....
4 p. m.	103.4	103.6	.....
5 p. m.	103.4	103.4	.....
6 p. m.	102.8	102.6	.....
7 p. m.	102.4	103.0	.....
8 p. m.	102.6	103.0	.....
9 p. m.	102.0	102.8	.....
10 p. m.	103.2	102.4	.....
11 p. m.	[a] 103.6	102.4	.....
12 p. m.	103.8	102.4	.....

HOG NO. 1838. (H.)

	°F.	°F.	°F.
1 a. m.	102.0	102.0	101.6
2 a. m.	101.6	101.6	102.0
3 a. m.	101.2	101.6	102.2
4 a. m.	101.0	101.4	101.8
5 a. m.	101.4	101.8	102.0
6 a. m.	102.4	102.4	102.4
7 a. m.	102.6	102.4	102.0
8 a. m.	102.8	103.0	.....
9 a. m.	102.4	103.0	.....
10 a. m.	103.2	102.0	.....
11 a. m.	102.6	103.0	.....
12 m	102.2	103.2	.....
1 p. m.	102.2	103.0	.....
2 p. m.	102.0	103.0	.....
3 p. m.	102.0	103.0	.....
4 p. m.	102.4	103.0	.....
5 p. m.	103.0	103.2	.....
6 p. m.	101.6	102.6	.....
7 p. m.	101.4	102.2	.....
8 p. m.	101.8	102.0	.....
9 p. m.	101.2	102.2	.....
10 p. m.	101.8	101.4	.....
11 p. m.	[a] 101.8	101.8	.....
2 p. m.	102.2	102.4	.....

HOG NO. 1839. (?)[b]

Hour.	Feb. 27, before injection.	Feb. 28, after injection.	Mar. 1, after injection.
	°F.	°F.	°F.
1 a. m.	102.4	103.6	102.6
2 a. m.	101.4	102.2	103.0
3 a. m.	102.0	102.6	103.6
4 a. m.	103.4	102.4	104.2
5 a. m.	102.4	103.4	103.6
6 a. m.	102.2	104.0	103.6
7 a. m.	103.4	103.6	104.2
8 a. m.	103.8	103.6	.....
9 a. m.	103.2	104.0	.....
10 a. m.	102.4	104.2	.....
11 a. m.	102.8	103.8	.....
12 m	103.0	104.2	.....
1 p. m.	102.4	104.0	.....
2 p. m.	102.0	105.0	.....
3 p. m.	102.8	104.6	.....
4 p. m.	102.0	104.6	.....
5 p. m.	102.0	105.0	.....
6 p. m.	102.0	103.4	.....
7 p. m.	101.8	103.6	.....
8 p. m.	102.0	103.4	.....
9 p. m.	101.8	104.0	.....
10 p. m.	102.4	104.6	.....
11 p. m.	[a] 102.0	103.4	.....
12 p. m.	103.0	103.6	.....

HOG NO. 1840. (H.)

	°F.	°F.	°F.
1 a. m.	103.4	103.0	103.0
2 a. m.	103.0	102.8	102.4
3 a. m.	103.0	103.0	102.8
4 a. m.	103.0	102.4	103.0
5 a. m.	103.0	102.4	103.0
6 a. m.	103.2	102.4	102.4
7 a. m.	103.2	103.4	102.8
8 a. m.	103.6	103.0	.....
9 a. m.	103.8	102.6	.....
10 a. m.	103.2	102.6	.....
11 a. m.	102.8	103.2	.....
12 m	103.4	103.2	.....
1 p. m.	103.2	103.4	.....
2 p. m.	103.6	103.0	.....
3 p. m.	102.8	103.0	.....
4 p. m.	102.6	103.0	.....
5 p. m.	103.6	103.4	.....
6 p. m.	102.8	103.6	.....
7 p. m.	103.2	103.2	.....
8 p. m.	102.8	103.4	.....
9 p. m.	102.6	103.0	.....
10 p. m.	102.2	103.0	.....
11 p. m.	[a] 103.2	102.4	.....
12 p. m.	103.0	102.8	.....

[a] Injected with ½ c. c. of tuberculin at this hour.
[b] Probably affected with very recent tuberculosis.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1841. (H.)			
Hour.	Feb. 27, before injection.	Feb. 28, after injection.	Mar. 1, after injection.
	°F.	°F.	°F.
1 a. m	100.6	102.0	102.8
2 a. m	101.4	102.8	102.0
3 a. m	102.0	102.2	102.0
4 a. m	102.4	101.4	101.8
5 a. m	102.4	101.4	101.0
6 a. m	101.6	101.2	101.2
7 a. m	102.2	101.2	101.0
8 a. m	101.6	102.0	.....
9 a. m	101.8	102.6	.....
10 a. m	101.0	102.6	.....
11 a. m	101.8	102.6	.....
12 m	102.6	103.6	.....
1 p. m	102.8	103.0	.....
2 p. m	102.4	103.0	.....
3 p. m	102.8	103.0	.....
4 p. m	102.6	103.6	.....
5 p. m	103.2	103.6	.....
6 p. m	102.8	103.8	.....
7 p. m	103.0	102.6	.....
8 p. m	102.8	102.8	.....
9 p. m	102.4	103.4	.....
10 p. m	102.4	103.0	.....
11 p. m	[a]102.4	103.2	.....
12 p. m	102.4	102.0	.....

HOG NO. 1843. (T.)[b]			
Hour.	Feb. 27, before injection.	Feb. 28, after injection.	Mar. 1, after injection.
	°F.	°F.	°F.
1 a. m	103.6	103.0	103.2
2 a. m	103.6	103.4	102.8
3 a. m	103.0	102.8	103.0
4 a. m	103.2	102.4	103.6
5 a. m	103.0	102.4	103.2
6 a. m	104.0	102.0	103.2
7 a. m	103.4	102.4	103.2
8 a. m	103.6	104.2	.....
9 a. m	103.0	103.6	.....
10 a. m	103.2	104.0	.....
11 a. m	102.6	103.0	.....
12 m	102.6	104.0	.....
1 p. m	102.4	103.6	.....
2 p. m	102.2	103.0	.....
3 p. m	103.0	103.2	.....
4 p. m	102.8	103.0	.....
5 p. m	103.0	103.8	.....
6 p. m	103.2	103.2	.....
7 p. m	102.6	102.8	.....
8 p. m	102.2	103.4	.....
9 p. m	102.8	103.2	.....
10 p. m	102.4	102.8	.....
11 p. m	[a]103.4	102.6	.....
12 p. m	103.8	103.2	.....

HOG NO. 1842. (T.)			
	°F.	°F.	°F.
1 a. m	104.4	104.0	104.4
2 a. m	104.0	103.8	105.0
3 a. m	104.4	104.0	104.8
4 a. m	104.2	103.8	104.2
5 a. m	104.0	103.8	104.2
6 a. m	104.0	103.8	103.4
7 a. m	103.8	103.8	103.4
8 a. m	103.6	103.8	.....
9 a. m	103.6	105.6	.....
10 a. m	103.2	105.0	.....
11 a. m	103.2	104.4	.....
12 m	103.6	106.0	.....
1 p. m	103.4	106.0	.....
2 p. m	103.6	106.0	.....
3 p. m	103.0	105.2	.....
4 p. m	103.2	106.4	.....
5 p. m	102.6	106.4	.....
6 p. m	103.0	106.4	.....
7 p. m	103.0	106.0	.....
8 p. m	103.0	105.8	.....
9 p. m	103.2	106.6	.....
10 p. m	102.8	105.0	.....
11 p. m	[a]103.8	105.4	.....
12 p. m	103.4	105.0	.....

HOG NO. 1844. (T.)[b]			
	°F.	°F.	°F.
1 a. m	103.0	103.8	104.0
2 a. m	104.0	103.8	103.6
3 a. m	103.6	103.8	103.8
4 a. m	103.8	103.4	103.4
5 a. m	104.4	104.0	104.2
6 a. m	104.2	104.2	104.2
7 a. m	104.0	103.4	104.2
8 a. m	104.6	104.2	.....
9 a. m	104.0	104.0	.....
10 a. m	104.6	104.2	.....
11 a. m	104.2	104.0	.....
12 m	103.6	104.2	.....
1 p. m	104.2	104.0	.....
2 p. m	104.6	104.8	.....
3 p. m	103.8	104.0	.....
4 p. m	103.2	104.6	.....
5 p. m	103.6	104.6	.....
6 p. m	103.4	104.4	.....
7 p. m	104.0	104.6	.....
8 p. m	103.2	104.2	.....
9 p. m	103.2	103.8	.....
10 p. m	103.0	104.4	.....
11 p. m	[a]103.6	103.4	.....
12 p. m	103.8	104.2	.....

[a] Injected with $\frac{1}{2}$ c. c. of tuberculin at this hour.
[b] See also second test of this hog. Probably contracted tuberculosis after the first test and before the second.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1874. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	°F.	°F.
1 a. m	102.6	101.6
2 a. m	102.4	101.2
3 a. m	102.8	100.8
4 a. m	102.2	102.0
5 a. m	102.4	101.6
6 a. m	101.8	101.0
7 a. m	102.4	101.4
8 a. m	102.0	102.2
9 a. m	103.6	102.0
10 a. m	103.6	102.2
11 a. m	103.6	102.6
12 m	102.0	102.0
1 p. m	101.8	102.4
2 p. m	102.8	102.0
3 p. m	102.6	102.0
4 p. m	102.6	102.0
5 p. m	103.0	102.4
6 p. m	102.4	102.0
7 p. m	102.0	101.8
8 p. m	101.8	102.4
9 p. m	101.8	101.2
10 p. m	101.4	100.8
11 p. m	a 101.4	101.2
12 p. m	101.8	101.2

HOG NO. 1875. (A.)

	°F.	°F.
1 a. m	102.4	101.6
2 a. m	101.8	101.0
3 a. m	102.6	101.4
4 a. m	101.8	101.8
5 a. m	101.8	101.6
6 a. m	100.8	101.6
7 a. m	101.2	102.8
8 a. m	102.0	102.8
9 a. m	103.0	102.8
10 a. m	102.8	102.8
11 a. m	103.0	103.0
12 m	102.8	102.8
1 p. m	102.4	102.8
2 p. m	102.6	103.2
3 p. m	103.0	103.6
4 p. m	103.2	103.4
5 p. m	103.6	102.6
6 p. m	103.6	102.8
7 p. m	103.4	102.8
8 p. m	103.4	102.8
9 p. m	102.0	103.0
10 p. m	102.0	102.4
11 p. m	a 102.0	102.2
12 p. m	102.0	102.2

HOG NO. 1876. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	°F.	°F.
1 a. m	100.8	101.8
2 a. m	100.8	101.2
3 a. m	101.0	101.6
4 a. m	101.0	101.2
5 a. m	101.2	101.2
6 a. m	101.6	101.4
7 a. m	101.8	102.0
8 a. m	101.8	102.0
9 a. m	102.2	102.0
10 a. m	102.0	103.0
11 a. m	102.0	104.0
12 m	103.0	103.6
1 p. m	102.0	102.6
2 p. m	102.6	102.0
3 p. m	102.0	101.8
4 p. m	102.4	102.0
5 p. m	102.4	102.4
6 p. m	102.0	102.0
7 p. m	102.4	101.8
8 p. m	102.0	101.6
9 p. m	101.6	101.4
10 p. m	101.8	101.0
11 p. m	a 101.6	101.0
12 p. m	101.6	101.2

HOG NO. 1877. (A.)

	°F.	°F.
1 a. m	101.8	102.2
2 a. m	102.2	101.8
3 a. m	102.0	101.6
4 a. m	101.8	101.8
5 a. m	101.4	102.6
6 a. m	102.4	102.4
7 a. m	103.2	101.6
8 a. m	102.2	101.6
9 a. m	103.4	101.8
10 a. m	102.8	102.6
11 a. m	102.6	103.2
12 m	103.0	102.6
1 p. m	102.8	102.0
2 p. m	102.8	102.6
3 p. m	102.0	103.0
4 p. m	103.0	102.2
5 p. m	102.6	102.4
6 p. m	102.6	102.0
7 p. m	102.0	102.0
8 p. m	102.2	102.2
9 p. m	102.6	101.6
10 p. m	101.6	102.2
11 p. m	a 102.4	102.0
12 p. m	102.0	102.0

a Injected with $\frac{1}{2}$ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1878. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	°F.	°F.
1 a. m.	101.0	103.0
2 a. m.	102.0	103.0
3 a. m.	101.8	103.0
4 a. m.	101.8	102.8
5 a. m.	102.0	102.6
6 a. m.	102.4	102.8
7 a. m.	102.6	102.8
8 a. m.	103.4	103.4
9 a. m.	103.2	103.2
10 a. m.	102.0	102.2
11 a. m.	102.2	102.8
12 m.	102.4	103.0
1 p. m.	102.2	102.8
2 p. m.	102.4	102.0
3 p. m.	102.4	102.4
4 p. m.	103.4	103.0
5 p. m.	103.0	103.0
6 p. m.	102.6	103.0
7 p. m.	102.6	102.6
8 p. m.	102.8	102.8
9 p. m.	102.4	102.4
10 p. m.	102.0	102.2
11 p. m.	[a] 102.4	102.2
12 p. m.	103.0	102.2

HOG NO. 1880. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	°F.	°F.
1 a. m.	102.0	103.4
2 a. m.	103.2	103.2
3 a. m.	103.0	103.0
4 a. m.	102.6	103.4
5 a. m.	102.6	103.0
6 a. m.	102.4	103.2
7 a. m.	102.4	103.4
8 a. m.	103.2	103.6
9 a. m.	103 0	103.4
10 a. m.	103.2	103.6
11 a. m.	103.0	103.6
12 m.	103.2	103.0
1 p. m.	103.2	103.0
2 p. m.	103.2	102.8
3 p. m.	103.0	103.4
4 p. m.	103.0	103.4
5 p. m.	103.4	103.0
6 p. m.	103.0	102.8
7 p. m.	103.2	102.8
8 p. m.	103.0	102.8
9 p. m.	103.4	102.4
10 p. m.	102.4	103.2
11 p. m.	[a] 102.6	102.8
12 p. m.	103.2	102.6

HOG NO. 1879. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	°F.	°F.
1 a. m.	102.4	102.0
2 a. m.	102.8	101.6
3 a. m.	101.6	102.0
4 a. m.	101.2	102.4
5 a. m.	101.2	102.2
6 a. m.	100.8	102.0
7 a. m.	100.6	102.2
8 a. m.	101.8	102.8
9 a. m.	102.0	102.4
10 a. m.	101.6	102.4
11 a. m.	102.0	102.4
12 m.	102.4	102.2
1 p. m.	102.0	102.0
2 p. m.	102.0	102.0
3 p. m.	102.2	102.2
4 p. m.	102.4	102.0
5 p. m.	102.8	102.8
6 p. m.	102.8	101.8
7 p. m.	102.6	102.2
8 p. m.	102.4	102.0
9 p. m.	102.6	102.0
10 p. m.	102.4	102.0
11 p. m.	[a] 102.4	102.0
12 p. m.	102.2	102.0

HOG NO. 1881. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	°F.	°F.
1 a. m.	102.4	102.6
2 a. m.	102.0	102.2
3 a. m.	101.6	102.2
4 a. m.	101.6	102.0
5 a. m.	102.2	102.8
6 a. m.	102.6	102.4
7 a. m.	102.6	102.6
8 a. m.	102.8	102.2
9 a. m.	103.0	102.4
10 a. m.	102.8	102.4
11 a. m.	103.0	102.4
12 m.	103.2	101.4
1 p. m.	103.0	101.4
2 p. m.	102.8	101.6
3 p. m.	102.8	101.4
4 p. m.	102.6	102.0
5 p. m.	102.4	102.2
6 p. m.	102.6	101.6
7 p. m.	102.2	101.6
8 p. m.	102.0	101.2
9 p. m.	102.4	101.4
10 p. m.	102.8	101.4
11 p. m.	[a] 102.0	101.6
12 p. m.	101.6	101.4

[a] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1883. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	° *F.*	° *F.*
1 a. m.	102.2	103.2
2 a. m.	102.0	103.2
3 a. m.	101.8	103.0
4 a. m.	102.2	103.0
5 a. m.	102.6	103.2
6 a. m.	102.6	102.8
7 a. m.	102.0	102.6
8 a. m.	103.0	102.8
9 a. m.	103.4	103.0
10 a. m.	103.4	102.8
11 a. m.	102.8	102.6
12 m.	102.6	102.8
1 p. m.	102.6	102.4
2 p. m.	102.4	102.4
3 p. m.	103.0	102.2
4 p. m.	103.0	102.0
5 p. m.	103.2	102.4
6 p. m.	103.0	102.6
7 p. m.	103.2	102.2
8 p. m.	103.0	102.4
9 p. m.	103.0	102.6
10 p. m.	103.0	102.2
11 p. m.	[a] 103.2	103.0
12 p. m.	103.2	102.8

HOG NO. 1884. (A.)

	° *F.*	° *F.*
1 a. m.	102.2	102.6
2 a. m.	102.0	102.6
3 a. m.	102.4	102.0
4 a. m.	102.2	102.0
5 a. m.	102.0	102.4
6 a. m.	101.8	103.0
7 a. m.	101.6	102.8
8 a. m.	101.4	102.0
9 a. m.	102.8	102.8
10 a. m.	103.0	102.8
11 a. m.	103.0	102.8
12 m.	103.0	102.6
1 p. m.	102.8	102.0
2 p. m.	103.0	102.0
3 p. m.	103.0	102.4
4 p. m.	103.0	102.0
5 p. m.	103.0	102.6
6 p. m.	103.4	102.4
7 p. m.	103.0	102.4
8 p. m.	102.6	102.4
9 p. m.	102.4	102.2
10 p. m.	102.0	102.2
11 p. m.	[a] 102.2	102.4
12 p. m.	102.6	102.2

HOG NO. 1885. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	° *F.*	° *F.*
1 a. m.	102.8	103.0
2 a. m.	102.4	102.6
3 a. m.	102.2	102.4
4 a. m.	101.8	102.8
5 a. m.	101.8	102.6
6 a. m.	101.2	102.8
7 a. m.	101.4	102.6
8 a. m.	102.0	103.2
9 a. m.	102.4	103.2
10 a. m.	103.0	103.0
11 a. m.	103.4	103.0
12 m.	103.0	102.8
1 p. m.	103.2	103.0
2 p. m.	103.0	103.0
3 p. m.	102.6	102.4
4 p. m.	103.2	102.4
5 p. m.	103.2	102.8
6 p. m.	102.8	102.6
7 p. m.	102.8	102.4
8 p. m.	102.4	102.2
9 p. m.	103.0	102.2
10 p. m.	103.0	102.2
11 p. m.	[a] 102.6	103.0
12 p. m.	102.8	102.8

HOG NO. 1886. (A.)

	° *F.*	° *F.*
1 a. m.	102.2	101.8
2 a. m.	102.4	101.8
3 a. m.	102.4	101.8
4 a. m.	102.2	102.4
5 a. m.	102.2	102.0
6 a. m.	102.0	102.2
7 a. m.	102.0	101.8
8 a. m.	102.0	101.8
9 a. m.	102.4	102.2
10 a. m.	103.0	102.2
11 a. m.	103.8	102.0
12 m.	102.4	101.8
1 p. m.	102.2	101.8
2 p. m.	102.0	101.8
3 p. m.	102.4	102.0
4 p. m.	102.0	102.0
5 p. m.	102.4	102.0
6 p. m.	102.2	102.2
7 p. m.	102.4	102.4
8 p. m.	102.2	102.0
9 p. m.	102.4	102.0
10 p. m.	102.0	102.0
11 p. m.	[a] 101.6	101.8
12 p. m.	102.0	101.8

[a] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1887. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	°F.	°F.
1 a. m.	104.2	103.2
2 a. m.	104.0	103.4
3 a. m.	104.0	103.6
4 a. m.	104.0	103.8
5 a. m.	103.8	103.6
6 a. m.	103.8	103.8
7 a. m.	103.6	103.8
8 a. m.	103.8	103.6
9 a. m.	103.6	103.6
10 a. m.	103.8	103.6
11 a. m.	103.6	103.6
12 m.	103.4	103.4
1 p. m.	103.8	103.4
2 p. m.	103.6	103.0
3 p. m.	103.6	103.0
4 p. m.	103.6	103.0
5 p. m.	103.2	103.2
6 p. m.	103.6	103.6
7 p. m.	103.4	103.6
8 p. m.	103.6	103.2
9 p. m.	103.4	103.6
10 p. m.	103.0	103.4
11 p. m.	[a] 103.8	103.0
12 p. m.	103.4	103.0

HOG NO. 1888. (A.)

	°F.	°F.
1 a. m.	102.4	102.6
2 a. m.	102.6	102.4
3 a. m.	102.0	102.4
4 a. m.	102.2	103.0
5 a. m.	102.2	103.0
6 a. m.	102.2	103.0
7 a. m.	102.2	103.0
8 a. m.	103.0	103.0
9 a. m.	102.4	103.4
10 a. m.	103.0	103.2
11 a. m.	103.6	103.6
12 m.	104.0	103.0
1 p. m.	103.4	102.8
2 p. m.	102.8	102.4
3 p. m.	102.6	103.2
4 p. m.	103.0	102.8
5 p. m.	102.6	102.8
6 p. m.	102.8	103.0
7 p. m.	103.0	102.8
8 p. m.	102.8	102.4
9 p. m.	102.4	102.0
10 p. m.	102.6	102.0
11 p. m.	[a] 101.4	102.4
12 p. m.	103.4	102.2

HOG NO. 1889. (A.)

Hour.	Mar. 6, before injection.	Mar. 7, after injection.
	°F.	°F.
1 a. m.	103.8	103.6
2 a. m.	103.8	103.2
3 a. m.	103.8	103.6
4 a. m.	103.6	103.2
5 a. m.	103.8	102.6
6 a. m.	103.8	103.6
7 a. m.	103.6	103.4
8 a. m.	103.4	103.4
9 a. m.	103.6	103.2
10 a. m.	103.6	103.4
11 a. m.	103.6	103.0
12 m.	103.4	103.0
1 p. m.	103.4	103.0
2 p. m.	103.4	103.0
3 p. m.	103.4	103.8
4 p. m.	102.2	103.0
5 p. m.	103.2	103.0
6 p. m.	103.4	103.2
7 p. m.	103.8	103.8
8 p. m.	103.4	103.6
9 p. m.	104.0	103.4
10 p. m.	103.6	103.2
11 p. m.	[a] 104.0	103.2
12 p. m.	103.4	103.2

HOG NO. 1891. (A.)

	°F.	°F.
1 a. m.	102.6	102.4
2 a. m.	103.0	101.6
3 a. m.	102.2	102.4
4 a. m.	102.0	102.4
5 a. m.	101.8	102.2
6 a. m.	101.8	102.4
7 a. m.	101.6	102.4
8 a. m.	102.8	102.2
9 a. m.	102.8	102.2
10 a. m.	103.0	102.6
11 a. m.	103.4	102.8
12 m.	102.8	102 6
1 p. m.	103.0	102.2
2 p. m.	102.6	102.4
3 p. m.	102.6	102.0
4 p. m.	102.4	102.2
5 p. m.	103.2	102.6
6 p. m.	103.0	102.6
7 p. m.	102.6	102.2
8 p. m.	103.6	102.0
9 p. m.	102.0	101.6
10 p. m.	102.2	101.8
11 p. m.	[a] 102.6	102.0
12 p. m.	104.0	101.8

[a] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1751. (T.)		
Hour.	Mar. 20, before injection.	Mar. 21, after injection.
	°F.	°F.
1 a. m.	101.6	102.4
2 a. m.	101.8	102.4
3 a. m.	101.6	102.6
4 a. m.	101.2	102.6
5 a. m.	101.4	102.8
6 a. m.	101.0	103.2
7 a. m.	101.2	104.0
8 a. m.	101.2	105.4
9 a. m.	101.2	104.6
10 a. m.	101.6	103.6
11 a. m.	101.8	105.2
12 m.	102.2	105.2
1 p. m.	102.2	105.2
2 p. m.	102.0	106.0
3 p. m.	102.4	106.0
4 p. m.	102.6	105.8
5 p. m.	102.6	106.2
6 p. m.	102.0	106.0
7 p. m.	102.2	105.8
8 p. m.	102.4	104.4
9 p. m.	102.6	104.8
10 p. m.	102.4	105.2
11 p. m.	[a] 102.6	104.4
12 p. m.	102.6	104.8

HOG NO. 1755. (T.)		
Hour.	Mar. 20, before injection.	Mar. 21, after injection.
	°F.	°F.
1 a. m.	100.6	103.8
2 a. m.	102.0	103.8
3 a. m.	102.0	103.8
4 a. m.	101.6	103.8
5 a. m.	101.2	104.0
6 a. m.	101.2	104.0
7 a. m.	101.2	104.6
8 a. m.	102.4	104.6
9 a. m.	103.0	105.2
10 a. m.	103.0	105.2
11 a. m.	103.0	105.0
12 m.	102.6	104.6
1 p. m.	103.0	104.4
2 p. m.	103.0	105.0
3 p. m.	102 6	104.2
4 p. m.	102.6	104.4
5 p. m.	103.0	103.8
6 p. m.	103.2	103.8
7 p. m.	102 8	104.2
8 p. m.	102.6	104.0
9 p. m.	102.2	103.8
10 p. m.	102.2	103.0
11 p. m.	[a] 102.4	104.2
12 p. m.	102.8	104.0

HOG NO. 1754. (T.)		
	°F.	°F.
1 a. m.	101.4	102.0
2 a. m.	100.2	101.6
3 a. m.	101.2	102.4
4 a. m.	101.4	102.6
5 a. m.	100.4	102.6
6 a. m.	101.2	102.0
7 a. m.	101.2	101.0
8 a. m.	101.6	101.6
9 a. m.	100.2	102 0
10 a. m.	101.0	103.4
11 a. m.	101.6	103.8
12 m.	101.8	103.0
1 p. m.	101.6	102.6
2 p. m.	101.8	102.8
3 p. m.	101.8	102.4
4 p. m.	102.0	102.4
5 p. m.	102.0	103.6
6 p. m.	102.6	102.8
7 p. m.	102.6	103.6
8 p. m.	102.6	103.0
9 p. m.	102.4	103.0
10 p. m.	102.4	102.8
11 p. m.	[a] 101.6	103.0
12 p. m.	102.0	103.0

HOG NO. 1772. (T.)		
	° F.	° F.
1 a. m.	101.8	101.6
2 a. m.	101.0	101.8
3 a. m.	100.6	101.8
4 a. m.	101.4	101.6
5 a. m.	101.2	103.0
6 a. m.	101.2	102.0
7 a. m.	101.4	104.2
8 a. m.	100.4	104.0
9 a. m.	101.0	104.2
10 a. m.	101.2	105.2
11 a. m.	101.4	105.6
12 m.	101.0	104.6
1 p. m.	102.0	104.6
2 p. m.	101.6	105.0
3 p. m.	101.4	105.2
4 p. m.	102.4	104.6
5 p. m.	102.4	105.4
6 p. m.	101.8	105.0
7 p. m.	102.0	104.8
8 p. m.	102.4	103.6
9 p. m.	102.2	103.8
10 p. m.	102.2	103.2
11 p. m.	[a] 102.2	102.8
12 p. m.	101.6	103.0

[a] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1783. (T.)		
Hour.	Mar. 20, before injection.	Mar. 21, after injection.
	° *F.*	° *F.*
1 a. m.	102.6	101.0
2 a. m.	101.8	100.8
3 a. m.	101.2	101.4
4 a. m.	102.6	102.2
5 a. m.	101.2	103.0
6 a. m.	102.0	103.2
7 a. m.	101.2	102.6
8 a. m.	101.2	105.0
9 a. m.	102.0	105.2
10 a. m.	102.0	103.6
11 a. m.	102.0	104.8
12 m.	102.0	103.8
1 p. m.	102.0	104.0
2 p. m.	102.0	104.8
3 p. m.	101.8	104.6
4 p. m.	101.8	105.0
5 p. m.	101.6	105.6
6 p. m.	101.4	104.6
7 p. m.	101.6	104.8
8 p. m.	101.2	104.4
9 p. m.	101.2	104.0
10 p. m.	100.8	103.2
11 p. m.	[a] 101.8	103.6
12 p. m.	101.0	103.6

HOG NO. 1798. (T.)		
Hour.	Mar. 20, before injection.	Mar. 21, after injection.
	° *F.*	° *F.*
1 a. m.	100.8	102.4
2 a. m.	100.8	103.4
3 a. m.	101.2	103.6
4 a. m.	101.4	104.4
5 a. m.	101.2	105.6
6 a. m.	100.4	106.0
7 a. m.	100.2	106.0
8 a. m.	103.0	106.0
9 a. m.	103.2	106.0
10 a. m.	103.0	106.0
11 a. m.	103.0	105.4
12 m.	103.0	105.4
1 p. m.	103.0	104.0
2 p. m.	103.2	104.6
3 p. m.	103.0	104.6
4 p. m.	103.0	104.2
5 p. m.	103.2	104.0
6 p. m.	102.6	104.0
7 p. m.	103.0	104.0
8 p. m.	103.0	103.6
9 p. m.	102.4	103.4
10 p. m.	102.2	103.0
11 p. m.	[a] 102.8	103.8
12 p. m.	102.6	103.4

HOG NO. 1790. (T.)		
	° *F.*	° *F.*
1 a. m.	100.6	101.4
2 a. m.	100.0	101.4
3 a. m.	100.2	101.6
4 a. m.	100.2	101.2
5 a. m.	100.0	100.6
6 a. m.	100.0	100.4
7 a. m.	100.0	100.6
8 a. m.	99.0	100.2
9 a. m.	101.0	100.6
10 a. m.	101.2	100.4
11 a. m.	101.2	101.2
12 m.	101.4	100.8
1 p. m.	101.2	101.0
2 p. m.	101.2	102.0
3 p. m.	101.2	102.2
4 p. m.	101.0	102.2
5 p. m.	101.6	102.8
6 p. m.	101.6	103.0
7 p. m.	101.4	102.4
8 p. m.	102.0	103.0
9 p. m.	102.0	102.8
10 p. m.	101.8	102.8
11 p. m.	[a] 101.4	103.0
12 p. m.	101.6	102.8

HOG NO. 1801. (T.)		
	° *F.*	° *F.*
1 a. m.	101.8	100.6
2 a. m.	101.2	100.6
3 a. m.	101.6	100.4
4 a. m.	101.6	100.6
5 a. m.	101.4	100.0
6 a. m.	101.2	101.2
7 a. m.	101.2	102.0
8 a. m.	101.4	103.0
9 a. m.	102.2	105.0
10 a. m.	102.0	105.0
11 a. m.	102.0	105.0
12 m.	101.6	104.8
1 p. m.	101.8	105.2
2 p. m.	101.0	105.0
3 p. m.	101.2	105.0
4 p. m.	101.4	105.0
5 p. m.	102.0	105.6
6 p. m.	102.2	104.8
7 p. m.	102.6	104.2
8 p. m.	102.2	104.2
9 p. m.	101.8	103.8
10 p. m.	101.8	103.8
11 p. m.	[a] 101.2	103.2
12 p. m.	100.6	103.2

[a] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1803. (T.)

Hour.	Mar. 20, before injection.	Mar. 21, after injection.
	°F.	°F.
1 a. m.	101.6	104.2
2 a. m.	100.8	105.0
3 a. m.	100.8	105.2
4 a. m.	101.2	105.2
5 a. m.	101.4	106.0
6 a. m.	102.0	106.2
7 a. m.	101.2	106.2
8 a. m.	102.0	106.0
9 a. m.	103.0	106.0
10 a. m.	102.8	106.0
11 a. m.	103.0	105.6
12 m.	103.0	105.6
1 p. m.	103.0	103.6
2 p. m.	102.8	104.2
3 p. m.	102.2	104.4
4 p. m.	102.8	104.6
5 p. m.	103.2	106.0
6 p. m.	103.6	105.4
7 p. m.	103.6	105.0
8 p. m.	104.0	104.8
9 p. m.	104.2	105.0
10 p. m.	105.0	104.8
11 p. m.	a104.0	105.4
12 p. m.	104.6	105.0

HOG NO. 1805. (T.)

	°F.	°F.
1 a. m.	101.6	101.4
2 a. m.	101.0	101.6
3 a. m.	100.2	101.8
4 a. m.	100.4	101.6
5 a. m.	100.2	102.0
6 a. m.	100.0	102.6
7 a. m.	100.4	103.4
8 a. m.	101.2	103.0
9 a. m.	101.8	103.8
10 a. m.	101.6	103.8
11 a. m.	101.8	104.8
12 m.	102.0	104.6
1 p. m.	102.2	105.0
2 p. m.	102.4	105.2
3 p. m.	102.0	104.6
4 p. m.	102.0	104.6
5 p. m.	102.2	104.4
6 p. m.	102.2	104.4
7 p. m.	101.8	104.2
8 p. m.	101.6	103.8
9 p. m.	101.8	103.2
10 p. m.	102.2	102.8
11 p. m.	a102.2	103.8
12 p. m.	101.4	103.6

HOG NO. 1809. (T.)

Hour.	Mar. 20, before injection.	Mar. 21, after injection.
	°F.	°F.
1 a. m.	101.2	102.4
2 a. m.	101.2	102.4
3 a. m.	101.4	102.6
4 a. m.	101.2	102.8
5 a. m.	101.2	102.4
6 a. m.	101.0	103.2
7 a. m.	101.0	104.6
8 a. m.	101.8	104.2
9 a. m.	102.8	105.6
10 a. m.	102.6	106.2
11 a. m.	102.2	105.2
12 m.	102.4	106.2
1 p. m.	102.2	105.6
2 p. m.	102.4	106.2
3 p. m.	102.4	106.4
4 p. m.	102.8	106.8
5 p. m.	102.6	106.4
6 p. m.	102.2	106.0
7 p. m.	102.4	105.8
8 p. m.	102.6	105.2
9 p. m.	102.4	105.2
10 p. m.	102.4	105.0
11 p. m.	a102.2	104.8
12 p. m.	102.0	105.0

HOG NO. 1811. (T.)

	°F.	°F.
1 a. m.	102.0	102.6
2 a. m.	101.8	102.6
3 a. m.	102.0	103.0
4 a. m.	102.0	103.8
5 a. m.	101.2	105.0
6 a. m.	101.2	106.0
7 a. m.	102.4	106.4
8 a. m.	102.6	106.4
9 a. m.	103.0	106.2
10 a. m.	103.2	106.4
11 a. m.	102.6	105.6
12 m.	103.0	105.6
1 p. m.	103.2	105.6
2 p. m.	103.0	105.6
3 p. m.	102.6	105.0
4 p. m.	103.2	105.0
5 p. m.	102.4	105.2
6 p. m.	102.6	104.2
7 p. m.	102.6	104.6
8 p. m.	102.4	105.0
9 p. m.	102.4	104.4
10 p. m.	102.8	104.6
11 p. m.	a102.2	104.0
12 p. m.	102.2	104.2

a Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1383. (A.)

Hour.	Apr. 3, before injection.	Apr. 4, after injection.
	°F.	°F.
1 a. m	101.6	101.6
2 a. m	101.2	101.6
3 a. m	101.2	101.6
4 a. m	101.0	101.2
5 a. m	100.8	101.0
6 a. m	100.6	100.8
7 a. m	101.2	100.4
8 a. m	100.6	100.6
9 a. m	101.4	101.2
10 a. m	101.0	100.6
11 a. m	101.0	100.6
12 m	100.0	100.4
1 p. m	100.4	100.6
2 p. m	101.0	100.6
3 p. m	101.0	101.0
4 p. m	101.0	101.2
5 p. m	101.8	101.4
6 p. m	101.4	101.2
7 p. m	101.4	101.4
8 p. m	101.6	101.2
9 p. m	101.6	101.2
10 p. m	101.2	101.4
11 p. m	[a] 101.4	100.8
12 p. m	101.6	101.0

HOG NO. 1385. (A.)

Hour.	April 3, before injection.	April 4, after injection.
	°F.	°F.
1 a. m	102.0	102.4
2 a. m	101.8	102.2
3 a. m	102.0	102.2
4 a. m	101.8	102.0
5 a. m	102.0	102.6
6 a. m	102.4	102.2
7 a. m	102.2	102.0
8 a. m	102.4	101.6
9 a. m	102.8	102.0
10 a. m	102.0	101.6
11 a. m	103.0	101.6
12 m	102.2	101.6
1 p. m	102.2	101.6
2 p. m	102.6	101.8
3 p. m	102.2	101.6
4 p. m	102.0	101.6
5 p. m	102.2	102.2
6 p. m	102.0	102.0
7 p. m	101.8	102.4
8 p. m	101.0	102.2
9 p. m	101.8	102.0
10 p. m	101.8	102.0
11 p. m	[a] 102.0	102.0
12 p. m	102.2	101.8

HOG NO. 1384. (A.)

	°F.	°F.
1 a. m	101.8	101.8
2 a. m	101.8	102.0
3 a. m	101.8	102.2
4 a. m	101.8	102.2
5 a. m	102.0	101.8
6 a. m	102.0	102.2
7 a. m	102.4	102.4
8 a. m	101.8	101.6
9 a. m	102.0	102.0
10 a. m	102.0	101.8
11 a. m	102.0	101.6
12 m	101.6	101.4
1 p. m	101.8	101.6
2 p. m	101.2	101.4
3 p. m	101.8	101.2
4 p. m	101.8	101.4
5 p. m	101.6	101.2
6 p. m	102.0	101.4
7 p. m	101.6	101.8
8 p. m	102.2	101.4
9 p. m	101.8	101.0
10 p. m	101.8	101.0
11 p. m	[a] 102.0	101.4
12 p. m	102.0	101.2

HOG NO. 1399. (A.)

	°F.	°F.
1 a. m	100.2	100.6
2 a. m	101.6	100.6
3 a. m	101.0	100.6
4 a. m	101.2	100.4
5 a. m	101.4	100.6
6 a. m	100.8	100.4
7 a. m	101.2	101.0
8 a. m	101.2	101.4
9 a. m	101.0	100.4
10 a. m	101.6	101.0
11 a. m	101.4	101.0
12 m	101.2	101.0
1 p. m	101.2	100.0
2 p. m	101.0	100.0
3 p. m	101.0	101.2
4 p. m	101.4	101.0
5 p. m	101.2	101.2
6 p. m	102.0	101.4
7 p. m	101.0	102.0
8 p. m	100.8	100.8
9 p. m	101.0	100.8
10 p. m	100.4	100.6
11 p. m	[a] 100.4	100.8
12 p. m	100.8	101.0

[a] Injected with 1 c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1446. (A.)		
Hour.	Apr. 3, before injection.	Apr. 4, after injection.
	°F.	°F.
1 a. m.	100.8	101.0
2 a. m.	100.8	101.4
3 a. m.	100.8	101.4
4 a. m.	100.6	101.2
5 a. m.	100.4	101.6
6 a. m.	100.4	101.6
7 a. m.	100.2	102.0
8 a. m.	100.6	101.2
9 a. m.	101.8	101.2
10 a. m.	101.6	101.2
11 a. m.	101.8	100.8
12 m.	101.8	101.6
1 p. m.	101.6	101.2
2 p. m.	101.6	101.0
3 p. m.	101.4	101.4
4 p. m.	102.0	101.4
5 p. m.	101.6	102.0
6 p. m.	101.4	102.0
7 p. m.	101.2	101.0
8 p. m.	100.8	101.2
9 p. m.	101.0	101.2
10 p. m.	101.2	101.2
11 p. m.	[a] 100.8	101.4
12 p. m.	100.8	101.2

HOG NO. 1895. (H.)		
Hour.	Apr. 3, before injection.	Apr. 4, after injection.
	°F.	°F.
1 a. m.	101.8	102.6
2 a. m.	102.0	102.6
3 a. m.	102.0	102.8
4 a. m.	102.0	102.4
5 a. m.	101.8	103.2
6 a. m.	102.0	104.0
7 a. m.	102.0	104.0
8 a. m.	102.4	103.4
9 a. m.	102.2	103.4
10 a. m.	102.2	103.8
11 a. m.	102.2	103.8
12 m.	102.4	103.4
1 p. m.	101.8	103.4
2 p. m.	102.2	102.6
3 p. m.	102.2	102.8
4 p. m.	101.6	103.2
5 p. m.	102.0	103.0
6 p. m.	102.2	103.4
7 p. m.	101.8	102.8
8 p. m.	102.6	103.0
9 p. m.	102.6	103.0
10 p. m.	102.2	102.6
11 p. m.	[b] 102.9	102.6
12 p. m.	102.0	102.6

HOG NO. 1527. (A.)		
	°F.	°F.
1 a. m.	100.4	101.0
2 a. m.	101.4	101.0
3 a. m.	101.2	101.0
4 a. m.	100.8	100.8
5 a. m.	100.8	101.2
6 a. m.	100.0	101.4
7 a. m.	100.2	101.4
8 a. m.	101.4	101.0
9 a. m.	101.4	100.4
10 a. m.	102.0	100.4
11 a. m.	101.6	101.0
12 m.	100.8	100.8
1 p. m.	100.8	100.8
2 p. m.	101.6	100.6
3 p. m.	101.2	100.4
4 p. m.	101.4	100.6
5 p. m.	102.6	101.0
6 p. m.	102.0	101.4
7 p. m.	101.6	101.4
8 p. m.	101.8	100.8
9 p. m.	101.2	101.2
10 p. m.	101.4	101.2
11 p. m.	[b] 101.0	100.8
12 p. m.	100.8	100.8

HOG NO. 1896. (A.)		
	°F.	°F.
1 a. m.	101.2	100.6
2 a. m.	101.0	100.4
3 a. m.	100.6	100.2
4 a. m.	100.8	100.2
5 a. m.	100.8	100.6
6 a. m.	101.2	100.8
7 a. m.	100.8	101.2
8 a. m.	100.8	101.4
9 a. m.	101.0	101.4
10 a. m.	101.6	101.0
11 a. m.	101.8	101.4
12 m.	101.8	101.0
1 p. m.	101.4	101.0
2 p. m.	100.8	100.4
3 p. m.	101.2	100.6
4 p. m.	101.6	101.6
5 p. m.	102.0	101.4
6 p. m.	101.8	101.6
7 p. m.	102.2	100.4
8 p. m.	102.0	101.0
9 p. m.	101.0	100.6
10 p. m.	101.6	100.6
11 p. m.	[b] 101.2	101.2
12 p. m.	100.6	101.0

[a] Injected with 1 c. c. of tuberculin at this hour. [b] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1897. (A.)		
Hour.	Apr. 3, before injection.	Apr. 4, after injection.
	°F.	°F.
1 a. m.	101.8	103.0
2 a. m.	102.0	102.8
3 a. m.	101.6	102.8
4 a. m.	101.6	102.6
5 a. m.	101.4	102.4
6 a. m.	101.0	102.0
7 a. m.	101.6	102.6
8 a. m.	101.6	102.4
9 a. m.	102.0	102.8
10 a. m.	101.8	103.0
11 a. m.	102.0	103.2
12 m.	102.4	102.4
1 p. m.	102.4	102.8
2 p. m.	102.2	102.4
3 p. m.	102.2	102.4
4 p. m.	102.2	103.0
5 p. m.	102.6	102.8
6 p. m.	102.6	102.8
7 p. m.	103.0	102.4
8 p. m.	102.6	102.8
9 p. m.	102.2	102.2
10 p. m.	102.4	102.0
11 p. m.	[a]102.4	102.0
12 p. m.	102.6	102.2

HOG NO. 1855. (T.)[b]		
Hour.	Apr. 3, before injection.	Apr. 4, after injection.
	°F.	°F.
1 a. m.	102.0	103.6
2 a. m.	102.0	103.8
3 a. m.	101.8	103.6
4 a. m.	101.8	103.8
5 a. m.	102.0	104.6
6 a. m.	102.2	104.6
7 a. m.	102.2	104.2
8 a. m.	102.0	105.0
9 a. m.	102.4	105.2
10 a. m.	102.4	105.2
11 a. m.	103.0	106.2
12 m.	102.2	105.6
1 p. m.	102.2	105.8
2 p. m.	102.4	106.0
3 p. m.	102.4	106.0
4 p. m.	102.0	106.4
5 p. m.	103.0	106.2
6 p. m.	102.8	106.2
7 p. m.	103.4	106.6
8 p. m.	103.8	106.4
9 p. m.	103.6	106.2
10 p. m.	103.8	106.4
11 p. m.	[a]103.4	106.2
12 p. m.	103.0	106.2

HOG NO. 1854. (T.)[b]		
	°F.	°F.
1 a. m.	103.8	103.4
2 a. m.	103.2	103.4
3 a. m.	103.2	104.0
4 a. m.	103.2	104.0
5 a. m.	103.4	105.0
6 a. m.	103.6	105.6
7 a. m.	103.4	106.0
8 a. m.	103.2	105.6
9 a. m.	102.2	105.0
10 a. m.	103.2	106.0
11 a. m.	103.0	106.2
12 m.	103.4	106.4
1 p. m.	103.0	106.0
2 p. m.	103.0	106.0
3 p. m.	103.0	105.8
4 p. m.	103.0	105.6
5 p. m.	103.2	106.4
6 p. m.	103.4	106.0
7 p. m.	103.4	106.0
8 p. m.	103.0	105.0
9 p. m.	103.0	105.0
10 p. m.	102.6	104.4
11 p. m.	[a]103.0	104.4
12 p. m.	103.0	104.2

HOG NO. 1856. (T.)[b]		
	°F.	°F.
1 a. m.	103.8	103.4
2 a. m.	104.0	103.6
3 a. m.	103.8	103.4
4 a. m.	103.8	103.4
5 a. m.	103.6	103.4
6 a. m.	103.6	103.8
7 a. m.	103.8	103.4
8 a. m.	103.0	104.0
9 a. m.	104.0	104.2
10 a. m.	103.8	103.8
11 a. m.	102.8	104.2
12 m.	103.2	104.8
1 p. m.	103.2	104.8
2 p. m.	103.0	105.0
3 p. m.	103.2	105.0
4 p. m.	103.0	104.6
5 p. m.	104.4	105.4
6 p. m.	103.8	105.2
7 p. m.	103.8	105.0
8 p. m.	103.4	106.0
9 p. m.	103.6	105.2
10 p. m.	103.6	105.4
11 p. m.	[a]103.8	105.4
12 p. m.	103.8	105.2

[a] Injected with ½ c. c. of tuberculin at this hour. [b] Second test.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1846. (T.)[a]		
Hour.	Apr. 3, before injection.	Apr. 4, after injection.
	° F.	° F.
1 a. m.	101.8	101.6
2 a. m.	101.8	102.0
3 a. m.	101.6	102.0
4 a. m.	101.8	101.8
5 a. m.	102.2	101.6
6 a. m.	102 2	101.2
7 a. m.	102.2	101.6
8 a. m.	102.4	102.2
9 a. m.	101.8	103.4
10 a. m.	102.0	104.2
11 a. m.	101.8	105.2
12 m.	101.8	105.0
1 p. m.	101.0	105.4
2 p. m.	101.4	105.4
3 p. m.	101.2	105.6
4 p. m.	101.4	105.6
5 p. m.	102.0	106.0
6 p. m.	101.8	106.0
7 p. m.	102.0	106.4
8 p. m.	102.0	106.4
9 p. m.	101.8	106.2
10 p. m.	102.0	106.0
11 p. m.	[b] 102.2	105.8
12 p. m.	101.6	106.0

HOG NO. 1849. (T.)[a]		
Hour.	Apr. 3, before injection.	Apr. 4, after injection.
	° F.	° F.
1 a. m.	101.4	101.6
2 a. m.	102.4	102.0
3 a. m.	102.4	102.4
4 a. m.	102.0	102.2
5 a. m.	102.0	102.2
6 a. m.	101.6	102.6
7 a. m.	101.8	103.0
8 a. m.	101.8	103.6
9 a. m.	102.6	103.8
10 a. m.	103.2	103.8
11 a. m.	103.0	104.2
12 m.	102.6	104.6
1 p. m.	102.4	105.0
2 p. m.	102.8	105.0
3 p. m.	102.4	104.8
4 p. m.	102.6	104.8
5 p. m.	103.4	105.4
6 p. m.	103.0	105.6
7 p. m.	102.2	105.4
8 p. m.	102.2	105.0
9 p. m.	102.2	105.2
10 p. m.	102.4	105.2
11 p. m.	[b] 102.2	105.2
12 p. m.	102.0	105.2

HOG NO. 1848. (T.)[a]		
	° F.	° F.
1 a. m.	102.6	103.0
2 a. m.	102.8	103.2
3 a. m.	103.0	103.4
4 a. m.	102.8	103.0
5 a. m.	103.0	103.0
6 a. m.	103.0	102.8
7 a. m.	103.2	102.4
8 a. m.	103.0	103.0
9 a. m.	102.4	103.0
10 a. m.	102.6	103.4
11 a. m.	102.6	103.0
12 m.	103.0	103.0
1 p. m.	102.4	103.0
2 p. m.	102.4	103.6
3 p. m.	102.4	103.4
4 p. m.	103.0	104.2
5 p. m.	103.4	105.6
6 p. m.	103.4	105.0
7 p. m.	103.6	105.6
8 p. m.	103.0	105.4
9 p. m.	103.4	105.0
10 p. m.	102.6	105.0
11 p. m.	[b] 102.6	105.0
12 p. m.	103.0	104.8

HOG NO. 1898. (A.)[a]		
	° F.	° F.
1 a. m	100.8	102.8
2 a. m	101.0	103.0
3 a. m	101.0	103.4
4 a. m	100.8	102.6
5 a. m	101.0	102.2
6 a. m	101.6	103.0
7 a. m	101.6	102.6
8 a. m	102.4	103.0
9 a. m	102.8	102.0
10 a. m	102.0	102.4
11 a. m	102.2	102.6
12 m	102.0	102.4
1 p. m	101.8	102.4
2 p. m	102.4	102.4
3 p. m	102.6	102.0
4 p. m	103.0	103.0
5 p. m	103.2	103.2
6 p. m	103.0	103.0
7 p. m	103.0	103.4
8 p. m	103.0	103.2
9 p. m	103.2	103.0
10 p. m	103.0	102.6
11 p. m	[b] 103.0	102.4
12 p. m	103.0	102.6

[a] Second test.

[b] Injected with ½ c. c. of tuberculin at this hour.

Table showing the temperature of hogs before and after injection—Continued.

HOG NO. 1838. (H.)[a]		
Hour.	Apr. 3, before injection.	Apr. 4, after injection.
	° *F.*	° *F.*
1 a. m	101.0	100.6
2 a. m	100.8	100.6
3 a. m	100.8	100.6
4 a. m	100.0	100.4
5 a. m	100.2	100.0
6 a. m	100.0	100.0
7 a. m	100.0	100.2
8 a. m	99.6	100.6
9 a. m	102.0	101.0
10 a. m	102.0	101.0
11 a. m	100.4	101.6
12 m	100.6	101.0
1 p. m	100.0	101.0
2 p. m	100.6	101.2
3 p. m	101.0	101.0
4 p. m	101.4	100.6
5 p. m	102.2	100.8
6 p. m	101.2	101.0
7 p. m	101.0	100.8
8 p. m	100.8	100.8
9 p. m	100.8	101.2
10 p. m	100.8	100.8
11 p. m	[b] 100.6	100.6
12 p. m	100.6	100.8

HOG NO. 1840. (H.)[a]		
	° *F.*	° *F.*
1 a. m	101.8	101.8
2 a. m	102.0	101.4
3 a. m	102.2	101.6
4 a. m	102.2	101.6
5 a. m	102.2	101.6
6 a. m	102.0	101.8
7 a. m	102.0	101.4
8 a. m	102.0	101.4
9 a. m	102.0	103.0
10 a. m	102.0	102.4
11 a. m	101.8	102.0
12 m	101.8	102.2
1 p. m	102.0	102.2
2 p. m	102.4	102.4
3 p. m	102.0	102.4
4 p. m	102.6	102.2
5 p. m	102.6	102.4
6 p. m	102.6	102.4
7 p. m	102.2	102.8
8 p. m	102.6	102.2
9 p. m	102.0	101.8
10 p. m	102.0	102.0
11 p. m	[b] 101.6	101.6
12 p. m	101.8	101.8

HOG NO. 1843. (T.)[a]		
Hour.	Apr. 11, before injection.	Apr. 12, after injection.
	° *F.*	° *F.*
1 a. m	101.0	101.0
2 a. m	101.2	101.0
3 a. m	101.6	101.0
4 a. m	101.0	101.0
5 a. m	101.0	101.8
6 a. m	100.8	102.4
7 a. m	101.6	103.0
8 a. m	101.4	103.6
9 a. m	100.4	105.0
10 a. m	102.0	104.2
11 a. m	101.6	104.4
12 m	101.0	104.0
1 p. m	100.0	103.6
2 p. m	100.8	104.0
3 p. m	101.0	104.0
4 p. m	101.0	104.0
5 p. m	101.6	104.2
6 p. m	101.6	103.6
7 p. m	101.6	102.6
8 p. m	102.0	102.6
9 p. m	101.2	102.6
10 p. m	101.2	102.2
11 p. m	[b] 101.8	102.2
12 p. m	101.2	102.2

HOG NO. 1844. (T.)[a]		
	° *F.*	° *F.*
1 a. m	103.6	103.6
2 a. m	103.8	103.4
3 a. m	103.8	103.6
4 a. m	103.8	104.0
5 a. m	103.6	104.2
6 a. m	103.2	104.6
7 a. m	103.6	105.6
8 a. m	103.2	106.0
9 a. m	103.2	106.6
10 a. m	103.6	106.4
11 a. m	103.0	106.6
12 m	102.2	106.6
1 p. m	102.0	106.4
2 p. m	102.8	106.6
3 p. m	103.0	106.4
4 p. m	103.0	106.0
5 p. m	103.2	106.2
6 p. m	104.0	106.2
7 p. m	103.6	106.2
8 p. m	103.4	106.0
9 p. m	103.4	105.2
10 p. m	103.0	104.8
11 p. m	[b] 103.4	104.2
12 p. m	103.4	104.0

[a] Second test.

[b] Injected with ½ c. c. of tuberculin at this hour.

Autopsy Records.

HOGS FED TUBERCULOUS MILK.

Hog No. 1853.—Found dead the morning of February 21, 1906. General condition excellent; fat. During the tuberculin test, both before and after the injection of tuberculin, the respiration was accompanied by a snoring sound and the number of respirations was greater than normal. Glands at the angles of the jaws (submaxillary) are enlarged, congested, and sprinkled with tuberculous foci. The gland back of pharynx (post-pharangeal) on left side is in the same condition. Other glands in region of throat are unaffected. The superficial inguinal glands on left side are ten times as large as those on the right and are entirely congested, but show no tuberculous lesions. (The tuberculin injection was made in the thigh near the enlarged glands.) The prepectoral gland directly in front of the trachea outside of the thorax and the corresponding glands just inside of the thorax are enlarged and sprinkled with foci of tuberculosis. Mediastinal and bronchial glands are greatly enlarged and contain cheesy material, which is beginning to soften. Lung is adherent to chest walls, heart, and diaphragm, and the different lobes to each other; the entire organ is thickly sprinkled with large tuberculous masses; the medium lobes are entirely cheesy, and at least one-half of the remainder of the lung is in the same condition. The portal glands are enlarged and necrotic. The liver is sprinkled with numerous tuberculous foci, from 1 to 3 mm. in diameter. The spleen contains a few tuberculous foci, from 1 to 3 mm. in diameter. The glands at the curvature of the stomach are enlarged and completely tuberculous. Only one mesenteric gland was found to contain lesions of tuberculosis.

Hog No. 1854.—Killed April 7, 1906. General condition excellent; fat. Right submaxillary gland is greatly enlarged, diameter about 4 cm., and completely tuberculous. Left prescapular gland contains a few tuberculous foci. The pulmonary pleura is greatly roughened and thickened and contains a number of tubercles, each about 5 mm. in diameter. The costal pleura and the pulmonary surface of the diaphragm contain a number of small tubercles from 1 to 5 mm. in diameter. The left cephalic lobe of the lung is tuberculous, and the other lobes are sprinkled thickly with tuberculous masses from 1 mm. to 1 cm. in diameter. The bronchial glands are studded with minute necrotic foci. The liver and spleen are sprinkled with numerous tuberculous foci from 1 to 3 mm. in diameter. Portal and gastric glands (glands at the curvature of the stomach) contain minute foci of tuberculosis. Minute tuberculous lesions found in three or four mesenteric glands.

Hog No. 1855.—Killed April 7, 1906. General condition excellent; fat. The submaxillary glands on both sides have a diameter from 4 to 5 cm., and are completely tuberculous. The prepectoral glands are enlarged and contain tuberculous foci. The lung is uniformly sprinkled with numerous tuberculous foci from 1 to 3 mm. in diameter. Both right and left bronchial glands contain small foci of tuberculosis. The liver has an even sprinkling of a small number of minute tuberculous foci, and the spleen is in the same condition. Gastro-hepatic chain of lymph glands contains tuberculous lesions. One mesenteric gland shows a tuberculous focus 2 mm. in diameter.

Hog No. 1856.—Killed April 7, 1906. General condition excellent. The submaxillary lymph glands on both sides are greatly enlarged and tuberculous. The lung is sprinkled uniformly with innumerable very minute, almost microscopic, and a few larger, tuberculous foci. The bronchial glands are somewhat enlarged, but show no tuberculous lesions. Two mesenteric glands contain each a tuberculous focus about 5 mm. in diameter.

Hog No. 1857.—Killed February 26, 1906. General condition excellent; fat. The right submaxillary gland is enlarged and contains a necrotic focus about 5 mm. in

diameter. About 1 out of every 3 mesenteric glands contains minute tuberculous foci.

Hog No. 1858.—Killed February 26, 1906. General condition excellent; fat. No lesions of disease found on autopsy.

Hog No. 1845.—Killed February 26, 1906. General condition excellent; fat. The submaxillary and prescapular glands on both sides are sprinkled with minute tuberculous foci. The superficial inguinal glands on both sides are greatly enlarged, edematous, and sprinkled with innumerable small foci of tuberculosis. Lung adherent to the chest wall and to the diaphragm, and the various lobes to each other. The two medium and the azygos lobes are completely tuberculous, and the principal lobes are thickly sprinkled with centers of tuberculosis from 1 mm. to 1 cm. in diameter. The bronchial glands on both sides are completely tuberculous, and a few small foci of tuberculosis are present in the mediastinal glands. One lymph gland at the curvature of the stomach contains a minute center of tuberculosis, and the mesenteric glands generally are sprinkled with small necrotic foci.

Hog No. 1846.—Killed April 7, 1906. General condition excellent; fat. Both submaxillary lymph glands are enlarged and tuberculous. Lung thickly sprinkled with minute foci of tuberculosis, and contains a few nodules between 1 and 2 cm. in diameter. Bronchial glands on both sides show tuberculous lesions. The liver contains a small number of minute tubercles. All the glands in the gastro-hepatic chain and about one-half in the mesenteric chain contain minute tuberculous foci.

Hog No. 1847.—Killed February 26, 1906. General condition excellent; fat. The submaxillary glands on both sides are greatly enlarged and entirely tuberculous. The prescapular glands on the right side show lesions of tuberculosis. The superficial inguinal glands on the right side are enlarged and edematous. The bronchial glands on the right side, the gastric glands, and practically all the mesenteric glands contain minute foci of tuberculosis. The mesenteric glands are enlarged and very edematous.

Hog No. 1848.—Killed April 7, 1906. General condition excellent; fat. Both submaxillary glands are greatly enlarged and tuberculous. The left prescapular and the left superficial inguinal glands contain each a necrotic focus, about 3 mm. in diameter. The lung contains innumerable minute tuberculous foci, evenly sprinkled through the anterior, medium, and azygos lobes; the principal lobes are comparatively free from lesions. Bronchial glands on both sides contain small areas of tuberculosis. The liver contains numerous tubercles from 1 to 2 mm. in diameter. Each gland in the gastro-hepatic and mesenteric chains of lymph glands contains 1 or 2 tuberculous foci from 5 mm. to 1 cm. in diameter.

Hog No. 1849.—Killed April 7, 1906. General condition excellent; fat. The submaxillary glands are from 4 to 5 cm. in diameter, and completely tuberculous. Lung is homogeneously sprinkled with minute tubercles. The right bronchial gland contains one tuberculous focus 4 mm. in diameter. The liver shows a few minute tuberculous areas. One mesenteric gland contains a focus of tuberculosis about 3 mm. in diameter.

Hog No. 1850.—Killed February 26, 1906. General condition excellent; fat. Both submaxillary glands are greatly enlarged and almost completely tuberculous. The prescapular and superficial inguinal glands on both sides are enlarged, edematous, and are sprinkled with minute necrotic areas. The lung is evenly sprinkled with innumerable tuberculous foci, 1 to 2 mm. in diameter. Bronchial glands on both sides show lesions of tuberculosis. Liver is uniformly sprinkled with foci of tuberculosis from 1 to 2 mm. in diameter. The gastric and mesenteric glands are generally enlarged, edematous, and sprinkled with minute centers of tuberculosis.

HOGS FED BEHIND CATTLE AFFECTED WITH NATURAL TUBERCULOSIS.

Hog No. 1837.—Killed March 1, 1906. General condition excellent; fat. No lesions of disease found on autopsy.

Hog No. 1838.—Killed April 13, 1906. General condition excellent; fat. No lesions of disease found on autopsy.

Hog No. 1839.—Killed March 1, 1906. General condition excellent; fat. The glands at the angles of the jaws (submaxillary glands) were at least five times as large as normal and intensely congested. No other lesions of disease found. Unfortunately, the submaxillary glands were soiled at the time of autopsy with a knife that had been previously used to section tuberculous material, and hence no further examination of them, by the microscope or by inoculation test, was made.

Hog No. 1840.—Killed April 13, 1906. General condition excellent; fat. No lesions of disease found on autopsy.

HOGS FED BEHIND HEALTHY CATTLE THAT WERE INGESTING TUBERCLE BACILLI.

Hog No. 1841.—Killed March 1, 1906. General condition excellent; fat. No lesions of disease found on autopsy.

Hog No. 1842.—Killed March 1, 1906. General condition excellent; fat. The left submaxillary gland is enormously enlarged and tuberculous throughout. The corresponding gland on the right side is enlarged and sprinkled with hemorrhagic markings. The prescapular gland on the right side is sprinkled with necrotic foci. The lungs are homogeneously studded with tuberculous areas from 1 to 3 mm. in diameter. Both the bronchial and mediastinal glands are sprinkled with minute tuberculous foci. Liver and spleen and the glands of the gastrohepatic chain are sprinkled with minute tubercles. The mesenteric glands are normal.

Hog No. 1843.—Killed April 13, 1906. General condition excellent, fat. Submaxillary glands on both sides contain a few small tuberculous areas. A few small tubercles from 1 to 2 mm. in diameter are found in the lung. No other lesions of disease.

Hog No. 1844.—Killed April 13, 1906. General condition excellent; fat. The right submaxillary gland is greatly enlarged and completely tuberculous. The lung is evenly sprinkled with innumerable tuberculous nodules from 1 to 2 mm. in diameter. The liver contains a much smaller number of similar nodules. No other lesions of disease.

HOGS INFECTED BY SUBCUTANEOUS INJECTION.

Hog No. 1751.—Killed March 23, 1906. At the seat of the inoculation is an abscess of about 5 mm. in diameter, which contains a dry, firm, cheesy material. The subcutaneous tissues surrounding the abscess, in a band less than 3 mm. wide, are sprinkled with minute necrotic foci. The lung contains a few small pearl-like tubercles, homogeneously distributed, 2 mm. and less in diameter.

Hog No. 1754.—Killed March 23, 1906. At the seat of inoculation is an abscess about 1 cm. in diameter, which contains a dry, firm, cheesy material. The subcutaneous tissues surrounding the abscess, in a band not more than 5 mm. wide, are sprinkled with minute necrotic foci. The lung is uniformly sprinkled with innumerable pearl-like tubercles, the largest of which are 2 mm. in diameter. The liver contains a few tuberculous foci 1 mm. and less in diameter. The spleen contains a very small number of tubercles from 1 to 2 mm. in diameter.

Hog No. 1755.—Killed March 23, 1906. Lesions at the seat of inoculation similar to that found in hog No. 1754. The inguinal lymph glands are slightly enlarged and contain several necrotic, tuberculous masses from 2 to 3 mm. in diameter. The prescapular lymph glands are slightly enlarged, and contain several necrotic, tuber-

culous areas, from 2 to 3 mm. in diameter; the number of affected areas is slightly greater than in the inguinal glands. The lung is evenly sprinkled w th innumerable, minute, pearl-like tubercles, the largest of which are 2 mm. in diameter. The bronchial lymph glands are enlarged and contain a small number of tuberculous areas. The liver is homogeneously sprinkled with innumerable very minute tubercles. The portal lymph glands contain a small number of minute tuberculous foci. The spleen contains several tubercles from 1 to 3 mm. in diameter.

Hog No. 1772.—Killed March 23, 1906. At the seat of the inoculation is an abscess about 5 mm. in diameter, which contains a dry, firm, cheesy material. The subcutaneous tissues surrounding the abscess, in a band less than 3 mm. wide, are sprinkled with minute necrotic foci. The lung contains many pearl-like tubercles, 2 mm. and less in diameter, located mostly in the apexes of the principal lobes. The liver contains a few small tubercles, the largest of which are 2 mm. in diameter.

Hog No. 1783.—Killed March 23, 1906. At the seat of the inoculation is an abscess about 1 cm. in diameter, which contains a dry, firm, cheesy material. The subcutaneous tissues surrounding the abscess, in a band not more than 5 mm. wide, are sprinkled with minute necrotic foci. The lung is evenly sprinkled with innumerable minute, pearl-like tubercles, 2 mm. and less in diameter. The liver contains a considerable number of very minute tubercles. The portal lymph glands contain a few very minute tuberculous foci.

Hog No. 1790.—Killed March 23, 1906. At the seat of the inoculation is an abscess about 1 cm. in diameter, the wall of which is a heavy, dense, neoplastic tissue, which incloses a mass of dry, firm, cheesy material. The lung contains about a score of minute, pearl-like tubercles, the largest of which is not more than 2 mm. in diameter. The liver shows one small tubercle, not more than 1 mm. in diameter.

Hog No. 1798.—Killed March 23, 1906.—The lesion at the seat of the inoculation is similar to that found in hog No. 1754. Lung homogeneously sprinkled with numerous pearl-like tuberculous nodules, from 1 to 2 mm. in diameter. The liver contains a few minute tubercles.

Hog No. 1801.—Killed March 23, 1906. At the seat of the inoculation is a lesion similar to that found in hog No. 1772, only about twice as large. The lung is sprinkled with numerous tuberculous nodules, from 1 to 3 mm. in diameter. The liver contains a few very small tubercles.

Hog No. 1803.—Killed March 23, 1906. At the seat of the inoculation is a lesion similar to that found in hog No. 1783, but not more than one-half as large. The inguinal lymph glands are enlarged, and some of them contain a small number of necrotic areas 4 mm. and less in diameter. The lung is uniformly sprinkled with innumerable tuberculous nodules, from 1 to 4 mm. in diameter. The bronchial lymph glands are enlarged and thickly studded with minute necrotic foci. The liver is sprinkled with numerous tubercles, the largest of which are 3 mm. in diameter. The portal lymph glands are enlarged and sprinkled with many necrotic foci from 1 to 2 mm. in diameter. The spleen contains a few tuberculous areas from 1 to 5 mm. in diameter. The lymph glands at the curvature of the stomach are enlarged and sprinkled with necrotic foci from 1 to 2 mm. in diameter.

Hog No. 1805.—Killed March 23, 1906. At the seat of the inoculation is an abcess in all respects similar to that found in the same region in hog No. 1751. The lung is homogeneously sprinkled with innumerable pearl-like tubercles, which vary in size from mere points to 2 mm. in diameter. The liver contains a few tuberculous foci 2 mm. and less in diameter.

Hog No. 1809.—Killed March 23, 1906. At the seat of the inoculation is a lesion precisely similar to that found in hog No. 1801. The lung is evenly sprinkled with pearl-like tubercles from 1 to 2 mm. in diameter. The liver contains a few very minute tubercles.

Hog No. 1811.—Killed March 23, 1906. At the seat of the inoculation is a lesion similar in all respects to that found in hog No. 1783. One of the inguinal lymph glands contains a few minute tuberculous foci. The lung is uniformly sprinkled with numerous pearl-like tubercles 2 mm. and less in diameter. The bronchial lymph glands are greatly enlarged and sprinkled with tuberculous foci, some of which have a diameter of 2 mm. The liver contains many tubercles from 1 to 3 mm. in diameter. The portal lymph glands contain several minute foci of tuberculosis. The spleen contains several tuberculous foci from 1 to 3 mm. in diameter.

Hog No. 1895.—Killed April 7, 1906. General condition excellent. No lesions of disease found on autopsy.

SOME METHODS BY WHICH HOGS MAY CONTRACT TUBERCULOSIS.

PLAN OF THE EXPERIMENT.

As we have already stated, the hogs used in the tuberculin tests are divided into five groups. Of these, Groups I, II, and III form part of a separate experiment made to gain information on the manner in which hogs become affected with tuberculosis in their natural environment. The hogs of Group IV have already been discussed in a previous article,[a] and the hogs of Group V are healthy, and it is not necessary that anything should be added to what has been said about them. Groups I, II, and III will be dealt with separately in detail.

HOGS OF GROUP I.

Hogs Nos. 1853, 1854, 1855, 1856, 1857, and 1858 were each fed daily 1,000 c. c. of artificially infected milk on December 18, 19, and 20, 1905. Hogs Nos. 1845, 1846, 1847, 1848, 1849, and 1850 were each fed daily 1,000 c. c. of artificially infected milk for thirty days, beginning December 7, 1905.

The milk was infected in the following manner: The surface growth of an agar culture of tubercle bacillus was scraped off and thoroughly broken up in 10 c. c. of sterile water, and the resulting faintly clouded suspension added to normal milk from healthy cows at the rate of 1 drop of suspension to 50 c. c. of milk. A fresh suspension of tubercle bacillus was made every other day.

With the exception of No. 1858, all the hogs contracted tuberculosis. No. 1853 died February 21, 1906, affected with generalized tuberculosis.

HOGS OF GROUP II.

Hogs Nos. 1837, 1838, 1839, and 1840 were placed in a small inclosure about 5 by 10 meters (approximately 2 square rods) in area, into which the feces of two tuberculous cattle, confined in an adjacent stable, were thrown. The cattle were fed heavily with corn in the manner in common practice on western farms in fattening cattle, behind which hogs are turned. The tuberculous condition of the cattle was

[a] Bulletin No. 86, Bureau of Animal Industry.

known through the agency of a tuberculin test; they had no cough and were not visibly diseased. Their feces were eagerly eaten by the four hogs. The exposure began December 7, 1905, and lasted until February 26, 1906, a total of eighty-one days.

On postmortem examination three of the hogs were found to be free from all lesions of disease, and one hog, No. 1839, had greatly enlarged and intensely congested submaxillary lymph glands. The tuberculin test of this hog, which was made on the two days immediately before it was killed, gave a positive reaction, and this, together with the fact that the submaxillary glands of hogs are among the first to become infected and are almost invariably infected when tuberculous material has been ingested, makes it very probable that the enlarged and congested condition of the glands was due to incipient tuberculous disease. There is little doubt that the glands would have shown well-marked tuberculous lesions had the hog been permitted to live two or three weeks longer.

HOGS OF GROUP III.

Hogs Nos. 1841, 1842, 1843, and 1844 were placed in a small inclosure about 5 by 10 meters in area, into which the feces of two healthy cattle were thrown. The cattle were confined in a stable adjacent to the inclosure, and received water to drink which was infected with material from a beef-broth culture of tubercle bacillus. The growth in the liquid culture was thoroughly broken up and added to the drinking water of the cattle at the rate of 1 drop per 50 c. c. of water. The suspension of bacilli in the beef broth gave it a distinct turbidity. The cattle were securely fastened in the forward ends of comparatively narrow stalls, and the infected water was taken to them through a passage in front of the stalls and was placed in iron receptacles.

Precautions were taken to prevent anything to the rear of the cattle from becoming infected with drippings from their noses and mouths after immersion in the water, and it is very improbable that any infectious material reached the rear of the cattle without first passing through their intestines. In all respects, excepting the infection of the drinking water, the cattle were treated precisely as the two tuberculous animals used in connection with the hogs of Group II. The exposure began December 7, 1905, and lasted until February 26, 1906, a period of eighty-one days.

On postmortem examination one of the hogs, No. 1841, was found to be free from lesions of disease and three were found to be affected with tuberculosis.

ANALYSIS AND DISCUSSION OF RESULTS.

The hogs of Group I show how readily these animals contract tuberculosis through the ingestion of milk infected with tuberculous material, and this fact is strongly emphasized by the results obtained

with 52 guinea pigs which were fed during three days with milk infected with tubercle bacilli in the same way as that given to the hogs. The guinea pigs were deprived of all food and drink for twenty-four hours before the milk was placed before them, and ingested about 175 c. c. each during the three days they were fed. They were killed about two months later and carefully examined postmortem, and not a lesion of tuberculosis was discovered.

If we take the total quantity of infected milk ingested by the 6 hogs that were fed three days, we have 18,000 c. c., and the total amount ingested by the 52 guinea pigs, we have 9,000 c. c. The average weight of the guinea pigs at the time they were killed was 624 grams (about 22 ounces) each, and of the hogs 34 kilograms (about 75 pounds) each; that is to say, the entire number of guinea pigs, representing 52 units that were exposed to infection, did not weigh quite as much as one of the hogs. Now, the remarkable fact is that 5 of the 6 hogs became affected with tuberculosis, and the entire 52 guinea pigs, which must certainly be regarded when the weight of the animals, the amount of milk ingested, and the number of units exposed are taken into consideration to have had a much more severe exposure, remained perfectly healthy. Two conclusions can be drawn from the experiment—either that hogs are very susceptible or that guinea pigs are very insusceptible to tuberculosis when the infectious agent is introduced into their bodies with food and the exposure is through the mouth, stomach, and intestines. Both conclusions are actually just and reasonable.

The insusceptibility of the guinea pigs is contrary to the usually accepted view of their high susceptibility, but the same condition was found with numerous other guinea pigs that were exposed to tuberculosis through ingestion and is perfectly compatible with the history of the thousands of guinea pigs that have been handled at the Bureau Experiment Station, where no spontaneous case of tuberculosis has ever been known to occur among guinea pigs.

That the tubercle bacillus used in these experiments was strongly virulent for guinea pigs was shown by a number of subcutaneous injections made with it, which caused rapidly fatal generalized tuberculosis in every guinea pig injected. Guinea pigs are extremely susceptible to tuberculosis when the infectious material is introduced under their skin or into their peritoneal cavity. In an article published in the Twenty-first Annual Report of the Bureau of Animal Industry for the year 1904, page 57, it was shown that the difference in delicacy between ingestion and intraperitoneal injection of milk as a test for the presence of tubercle bacilli is as 1 to 12,000, when guinea pigs are used as the test animal. While this proportion is, of course, based on an insufficient number of tests to permit its acceptance as absolutely correct, with the additional evidence furnished by the 6

hogs and 52 guinea pigs fed with artificially infected milk we are justified in concluding that little information can be gained about the infectiousness of milk from tuberculous cows by feeding it to guinea pigs, unless the guinea pigs contract tuberculosis, in which case we have evidence only that the milk tested in this way is very infectious.

The hogs of Group II did not give sufficiently definite results for quite satisfactory conclusions, although one of the four was almost certainly infected with tuberculosis, through no greater exposure than to feces of tuberculous cattle. It is reasonable to suppose that tubercle germs that are coughed up and swallowed by tuberculous cattle, or that reach their organs of digestion in some other way, may pass through the intestine and retain their original pathogenic virulence. The hogs of Group III show positively that tubercle germs swallowed by cattle may appear in their feces. Three out of the four hogs exposed to the feces of the two cattle that drank infected water contracted tuberculosis.

The system in practice in many portions of the country of turning a herd of hogs behind a herd of cattle that are being fattened for market may be accountable for tuberculosis among hogs if the disease exists among the cattle. Hogs associated in this way with cattle may be protected effectually from tuberculosis by applying the tuberculin test to the cattle and removing every animal from the herd that shows a reaction indicative of the presence of tuberculosis. And it is strongly recommended that, in regions where tuberculosis among hogs has been discovered, the cattle with which they are associated be first of all tested and reacting animals segregated or disposed of in a way that will insure against further harm from them.

The experiment of exposing hogs to the feces of tuberculous cattle and cattle that are swallowing infectious material is being repeated, and in the experiment now in progress even greater care is being taken than in the foregoing to prevent the introduction into the hog pens of any infectious material other than that which has actually passed through the bowels of the cattle.

By emphasizing the insusceptibility shown by our guinea pigs to tuberculosis through ingestion we do not wish to imply that it is safe for other species of animals and man to ingest material infected with the germs of tuberculosis; the contrary is shown to be true by the results obtained with the hogs, and by the greater frequency with which abdominal tuberculosis occurs among children during the age when milk forms a large portion of their diet, than among adults.

LOCATION OF LESIONS PRODUCED BY FEEDING EXPERIMENTS.

The distribution of the tuberculous lesions in the hogs that became affected with tuberculosis through the ingestion of the artificially infected milk and feces is shown in the following table. The table

shows simply in what glands and organs tuberculous lesions were found on postmortem examination, and no attempt is made to indicate the extent to which the involved organs and glands were affected.

Table showing distribution of lesions found in hogs exposed to tuberculosis through ingestion of infectious material.

Hog. No.	Lymph glands.										Organs.		
	Submaxillary.	Postpharyngeal.	Prepectoral.	Bronchial.	Mediastinal.	Hepatic (or portal).	Gastric.	Mesenteric.	Prescapular.	Superficial inguinal.	Lung.	Liver.	Spleen.
1853	+	+	+	+	+	+	+	+	.....	.....	+	+	+
1854	+	.....	.....	+	.....	+	+	+	+	.....	+	+	+
1855	+	.....	+	+	.....	+	+	+	.....	.....	+	+	+
1856	+	.....	.....	.....	.....	.....	.....	+	.....	.....	+	.....	.....
1857	+	.....	.....	.....	.....	.....	.....	+	.....	.....	.....	.....	.....
1845	+	.....	.....	+	+	.....	+	+	+	+	+	.....	.....
1846	+	.....	.....	+	.....	+	+	+	.....	.....	+	+	.....
1847	+	.....	.....	+	.....	.....	+	+	+	.....	.....	.....	.....
1848	+	.....	.....	+	.....	+	+	+	+	+	+	+	.....
1849	+	.....	.....	+	.....	.....	.....	+	.....	.....	+	+	.....
1850	+	.....	.....	+	.....	.....	+	+	+	+	+	+	.....
1839	+?	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1842	+	.....	.....	+	.....	+	+	.....	+	.....	+	+	+
1843	+	.....	.....	.....	.....	.....	.....	.....	.....	.....	+	.....	.....
1844	+	.....	.....	.....	.....	.....	.....	.....	.....	.....	+	+	.....
Total	15	1	2	10	2	6	9	11	6	3	12	9	4

The table shows that the submaxillary lymph glands, located at the angles of the jaw, were affected in every hog. These glands probably receive the drainage from the lips and a considerable portion of the mouth, and may be of such structure in hogs that it is difficult for tubercle germs to pass through them.

The lung, next in order, is the most frequent seat of disease. It was affected twelve times out of a possible fifteen, and in every instance contained the largest number of individual foci and the largest actual mass of tuberculous disease. The course taken by the infectious agent, with ingested tuberculosis, to the lung, is believed to be through the lymph channels and the blood. The former terminate in the vessels that carry the venous blood directly to the heart, and from the heart it is carried to the lung, where the germs are more or less effectually filtered out during its passage through the exceptionally fine and complex network of thin-walled capillaries. The innumerable lesions in the lung, and their more or less uniform distribution, both tend to support this view. This mode of infection is very strongly brought out in the experiments of Nicholas and Descos and of Ravenel, who proved by feeding healthy dogs on tuberculous fluid and examining the chyle in the thoracic duct a few hours later that tubercle bacilli may readily pass through the normal intestinal wall and infect the animal without causing any lesion in the alimentary tract.

The inhalation theory of the infection of the lung with tuberculosis is clearly shown to be unnecessary, and the frequency with which the

lung is affected among the experimental hogs, all of which contracted the affection through the ingestion of infectious material, shows that, although tuberculosis is more commonly a disease of the lung than of other organs, this is not necessarily due to the direct exposure of the lung to air in which tubercle bacilli are suspended. It is more probable that the infecting agent reaches the lung through the lymph and blood streams, as indicated, than through the air. When air in which solid particles are suspended is breathed, the tortuous, narrow passages, with moist surfaces, through which it must pass, should completely prevent the penetration of these solid particles to any great depth. The solid particles would lodge on the upper respiratory surfaces, and if not removed normally with mucus and other secretions through the mouth and nose, would be more apt to cause an affection of the local lymph glands, like the parotid, buccal, maxillary, pharyngeal, etc., than of the lung and the bronchial and mediastinal glands.

Next in the order of frequency with which various structures in the bodies of the hogs were affected are the mesenteric glands—eleven times in a possible fifteen. The mesentric disease was confined three times to a slight involvement of a single gland and one time to minute lesions in three or four glands. More general disease, with involvement of 33 per cent or more of the mesenteric glands, occurred seven times.

It should be noted that some relationship exists between the severity of the mesenteric disease and the severity of the exposure to which the hogs were subjected. Thus, 4 hogs that contracted tuberculosis through eating infected feces, the mildest form of exposure received, showed no disease of the mesenteric glands; 3 of the 5 hogs that were fed infected milk for three days showed very slight disease of the mesenteric glands, and 5 of the 6 that were fed infected milk for thirty days showed severe disease of the mesenteric glands.

In connection with the infection of the mesenteric glands it must be stated that the hogs used in the exposures to tuberculosis were young animals, less than 6 months old at the time they were killed and examined. Young animals and children have more voluminous lymph glands than older animals and adults, and their lymph glands are more frequently involved in disease. This may account to some extent for the frequency with which tuberculous lesions occurred in the mesenteric glands of the experimental hogs, as it does for the greater frequency with which abdominal tuberculosis occurs among children than among adults.

The bronchial glands stand fourth in the order of frequency, and were affected ten times in a possible fifteen, only one time less than the mesenteric glands. In every instance but one the affection of the bronchial glands was associated with disease of the lung, while the lung was affected three times without disease of the bronchial glands.

The order of frequency following the bronchial glands is, fifth, the

liver and the gastric glands (glands at the curvature of the stomach), each affected nine times; sixth, hepatic (portal) and prescapular glands, each affected six times; seventh, spleen, affected four times; eighth, superficial inguinal glands, affected three times; ninth, mediastinal and prepectoral glands, each affected two times; and, tenth and last, postpharyngeal glands, affected a single time.

The disease of the hepatic, or portal, glands was associated in every case with disease of the liver, and the liver was affected three times without accompanying disease of these glands. The disease in the liver generally partook more of the character of the lesions in the lung than in other structures—that is, with reference to the wide, even distribution of the foci of disease in the organ. The actual number of tuberculous foci in the liver was generally much smaller than in the lung.

The infrequency with which the mediastinal glands were affected as well as the comparatively great frequency with which remote glands like the prescapular and superficial inguinals contained lesions of tuberculosis is remarkable, and directs attention to the possibility of the infection of the meat of hogs even when their internal organs do not show lesions of extensive tuberculous disease.

The similarity in the distribution of the foci of disease in the lung and in the liver points directly to a similarity in the modes of infection, which, with both organs, is undoubtedly through the blood stream. Next to the lung no organ in the body has a capillary circulation that is as well adapted as that of the liver to act as a filter for the blood. If infectious material enters directly into the circulation through the capillaries supplied to the absorbing structures of the intestine, it is carried to the liver and has a chance to lodge there before it reaches the lung. The effectual manner in which the lung and the liver act as filters for the blood stream accounts for the infrequency with which tubercle bacilli can be detected in the blood of the general circulation.

SUMMARY OF PRACTICAL CONCLUSIONS.

1. The application of the tuberculin test to hogs is practicable, and the results obtained are as reliable as with cattle, provided the hogs are kept very quiet beginning some time before and throughout the entire test. The need for quiet can not be too much emphasized.

2. Hogs readily contract tuberculosis through the ingestion of infected food. Their susceptibility to tuberculosis through exposure to infected food is much greater than that of guinea pigs.

3. The feces of cattle that swallow tubercle bacilli are highly infectious for hogs that are exposed to them.

4. The feces of tuberculous cattle very probably contain numerous tubercle bacilli that reach the intestine through swallowing or otherwise.

5. Apart from the invariable infection of the submaxillary glands,

and the apparent dependence of the severity of the disease in the mesenteric glands on the amount of infectious material swallowed, the location of the tuberculous lesions in the body is undoubtedly dependent upon other causes than the channel through which the infectious material enters. This is especially shown to be true by such hogs as Nos. 1843 and 1844, in one of which the lesions were confined, in addition to the submaxillary glands, exclusively to the lung, and in the other to the lung and the liver.

While no hogs were included in the present experiments that were fed milk from tuberculous cows, we judge from experiments previously made, in which hogs were fed large quantities of such milk, that of the two methods—the exposure of hogs to the feces or to the milk of tuberculous cattle—the former has by far the greater danger, entirely apart from the fact that exposure to the feces, in the manner in which it occurs, is never a simple exposure to one thing, but a general exposure to all the infectious material that may pass from cattle irrespective of whether they are milk-producing animals or not.

Beef cattle behind which hogs are turned are usually young animals, and the percentage of tuberculosis among them, and more especially generalized or advanced tuberculosis, is very low. Dairy cattle, the average age of which is greater, show a much higher percentage of disease, and for this reason hogs associated with them will probably contract tuberculosis more frequently. This greater frequency must not be attributed entirely to the milk the hogs receive from the cows. No farmer and no dairyman who is acquainted with the value of the undigested grain or other nutriment in cattle feces as a food for hogs fails to feed as much of it as he possibly can. At the Experiment Station of the Bureau of Animal Industry several lots of hogs were kept, for experimental purposes, under identically the same conditions with the exception that some, in addition to their other feed, received a few shovelfuls of cow feces daily, and some a small quantity of milk. The results showed conclusively that either feces or milk caused an improvement in the condition of the hogs greatly in excess of what can be accounted for by the actual nutriment contained in the feces or milk. The feces when given with the ordinary feed produced results fully as good as the milk. Of three lots of hogs, all of which received the maximum amount of mill feed they could be made to eat, one lot was fed a small quantity of milk daily, and one the nutriment contained in a small quantity of cow feces. At the end of three months the hogs that received either milk or feces were in equally good condition, and had made a gain in weight of from 75 to 100 per cent greater than that made by the lot of hogs fed purely on mill feed.

It is a question whether the tuberculosis that occurs among hogs associated with dairy establishments is not more directly traceable to

the feces of tuberculous cows than to skim milk. Tuberculous cows with unaffected udders secrete milk infected with tubercle bacilli so rarely that the injection of such milk into the peritoneal cavities of guinea pigs (which is an exceedingly delicate test for the presence of tubercle bacilli) led to the inference in earlier investigations[a] "that if all cattle affected with advanced generalized tuberculosis and all cattle with diseased udders were eliminated from dairy herds, very little infected milk would reach the market." This inference should be modified by the conclusions drawn from investigations published in the Twenty-first Annual Report of the Bureau of Animal Industry (p. 65), in which it is pointed out that the danger that milk may become infected from the environment of tuberculous cattle is probably greater than through the milk-secreting structures of tuberculous cows with healthy udders, and hence that no tuberculous animals should be allowed to remain among dairy cattle or in dairy herds. This latter conclusion is still further emphasized by the results obtained in the experiments recorded in Bulletin No. 44 of this Bureau.

The feces of tuberculous cattle are a menace to hogs even when not deliberately fed to them. Very few establishments that keep both hogs and cattle make provisions effectually to prevent the access of the former to the manure heap on which the droppings of the latter are thrown. No farmer or stockman intentionally practices a system of feeding that is lacking in economy, and to know the benefits that are derived by hogs from the manure heap of stables containing heavily grain-fed dairy or beef cattle immediately causes its location in the hog yard. This practice is not harmful when the cattle are healthy; but when they are affected with tuberculosis it means, in the light of the evidence we now have, an almost certain transference of the disease to the hogs.

The following abstract of the work of H. Vallée, published in the Annales de l'Institut Pasteur, October 25, 1905, page 619, is very significant, and adds weight to the reasons we have presented relative to the frequency with which the lung becomes affected with tuberculosis and the channels through which the infectious material reaches the lung. Vallée draws attention to the incontestable fact that the pulmonary parenchyma constitutes the favorite seat for the location of the tubercle bacillus in all species of animals.

In statistics collected on 43,000 bovines the lungs have been shown to be affected in 75 per cent of cases of localized tuberculosis, and in all cases of generalized tuberculosis. Vallée inoculated 2 young calves by the intratracheal method and found on post-mortem examination six months later that the bronchial and mediastinal lymph glands and the lungs were without lesions, with the exception of 10 tubercular vegetations on the visceral pleura. Four other calves were infected by blowing a small

[a] Bulletins Nos. 3 and 7, Bureau of Animal Industry.

quantity of a pulverized culture of virulent tubercle bacilli into the naso-pharynx. In two of these cases the postpharyngeal lymph glands became involved, in one case the postpharyngeal and tracheal lymph glands developed lesions, while in the fourth calf the postpharyngeal, cervical, and tracheal glands showed tuberculosis, but in no instance were the pulmonary lymph glands, lungs, or other viscera affected.

Experiments were also carried out which seemed to indicate that an infection through the digestive tract constitutes a mode of inoculation which is extremely favorable to the production of pulmonary lesions.

As a result of his investigations Vallée concludes that of the various methods of infection ingestion is the one by which the most certain and the quickest tuberculization of the pulmonary lymph glands takes place. Moreover, the tubercle bacillus may pass through the intestinal walls without producing any appreciable lesion in the mucous membrane of the intestine or in the mesenteric lymph glands, and locate and multiply in the bronchial lymph glands.

The fact that it is difficult to produce tuberculosis of the lung and its lymph glands by direct injection of infectious material into the trachea is especially significant, while the conclusion that tubercle bacilli may pass through the intestinal walls and the neighboring lymph glands is in perfect harmony with the results obtained from our experiments.

Finally, we wish to add that the microscopic examination and inoculation tests of the feces and of scrapings from the walls of the rectum just inside of the anal opening of the cattle that drank infected water showed the presence of a considerable number of tubercle bacilli. The germs were all isolated and not in clumps. This fact shows more conclusively even than the tuberculous condition of the hogs exposed to the feces that the tubercle bacilli swallowed by the cattle actually passed through their stomachs and intestines and out through their rectums. The microscopic examination and inoculation test of the feces from an old tuberculous cow, not used in the experiment, that had been affected a number of years with naturally acquired tuberculosis, also showed the presence of tubercle bacilli, but in much smaller numbers than the feces of the cattle that drank the artificially infected water.

And this passage of tubercle bacilli, without loss of their pathogenic quality, from the mouth on entirely through and out of the intestinal tract of cattle, which is here experimentally demonstrated to be a fact, again leads us to call attention to the danger that normal milk from healthy cattle may be highly infectious if the dairy cows by which it is produced are stabled or pastured or otherwise associated with tuberculous cattle.

The desirability of the application of the tuberculin test to all cattle increases with every new investigation of the subject made.

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